

POPULAR SCIENCE

MONTHLY

Mechanics & Handicraft

JUNE

15¢



*Coming
in 2 Years!*

SEE PAGE 78



HERE'S THE CHAMPION FOR YOUR CAR

MODEL	YEAR						
	'34	'35	'36	'37	'38	'39	'40
AUBURN	7						
	H10						
	14 mm. Hds.						
AUSTIN AM. BANT.	C7	C7	C7	C7	J8	H10	H10
BUICK	15	15	15	15	J8	J8	J8
CADILLAC	7	7	8 cyl. J8 Others 7			Y4	Y4
CHEVROLET	J5	J5	J8	J8	J8	J8	J8
CHRYSLER	All Reg. Hds. J8						
	Alum. Hl. Hds. H10						
CORD	C7	C7	H10	H10	H10		
DE SOTO	All Reg. Hds. J8						
	Alum. Hl. Hds. H10						
DE VAUX		C7					
DODGE	All Reg. Hds. J8						
	Alum. Hl. Hds. H10						
DUESENBERG	6M	6M	6M	6M	6M	6M	
FIAT					P5	P5	P5
	Models A & B 3X						
	Big V8 18mm. Hd.						
	7	7	7	7	7		
FORD	1938 Big V8 14mm. Hd. H10						All Mdls. H10
	'32	V8	C4	60 H10	H.P. H10		
FRANKLIN	C7	C7	C7	C7			
	C4	7	7	7	H10		
GRAHAM	Sup- ced 7	Superchgd & 95 Ser. H10				H10	J10 Com
HUDSON	6s J8	All Reg. Hds. J8					
	8s 7	All Hl. Hds. H10					
HUPMOBILE	C7	C7	C7		7	7	7
LAFAYETTE	15	7	7	7	7	7	
LA SALLE	7	J8	J8	J8	J8	Y4	Y4
LINCOLN	7	7	7	7	7	7	H10
MARMON	C7						
MERCURY						H10	H10
NASH	To '29-6						
	L-Hd. C7						
	Ov. Hd. Vol. 15 14mm. Hd., J5			J8	J8	J8	J8
OLDSMOBILE	7	7	7	J8	J8	J8	J8
OVERLAND						J8	
PACKARD	J8	J8	J8	Y4	Y4	Y4	Y4
PIERCE ARROW	12 Cyl.-J5 8 Cyl.-C4		H10	H10	H10		
PLYMOUTH	All Reg. Hds. J8						
	Alum. Hl. Hds. H10						
PONTIAC	J8	J8	J8	J8	J8	J8	J8
REO	C7	C7	H10				
	1935 Alum. Hd. 7						
STUDEBAKER	All Reg. Hds. 8						
	Hl. Hds. 7						
STUTZ	6M	6M	6M	6M	6M	6M	
TERRAPLANE	All Reg. Hds. J8						
	Hl. Hds. H10						
WILLYS 4, 6 & 8	C7	C7	C7	C7	C7	J8	J8
WILLYS KNIGHT	Big 6, 66 Series, C4						
	Light 6, 6						
ZEPHYR			H10	H10	H10	H10	H10

WITH NEW CHAMPION Spark Plugs!

EVERYONE KNOWS that old, worn-out or inferior quality spark plugs, or those that have had 10,000 miles or more service, greatly impair engine performance and economy. But because deterioration is gradual, and hence not always noticed—millions of motorists depend on Change Week to remind them that a new set of Champion Spark Plugs definitely restores lost power, speed, economy and dependability.

Your Champion Spark Plug dealer renders special spark plug service this week. Checking and cleaning will reveal where new spark plugs are necessary to



restore lost "pick up and go."

Demand Champions, if new spark plugs are needed, because they make every engine a better performing engine; because they are the spark plugs champions use; because they alone have the leakproof qualities so necessary in today's high compression engines. Pick up and go to your Champion Spark Plug dealer NOW, because you can depend on him to put new "pick up and go" in your car.

POPULAR SCIENCE

Founded 1872

MONTHLY
Mechanics & Handicraft

Volume 136, No. 6

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GEORGE H. WALTZ, Jr., Associate Editor

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Can we get athletic records from the test tube? Read how chemistry may make champions, in an article on page 54

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THE HOME WORKSHOP begins on page 129

Published monthly at 353 Fourth Avenue, New York, N. Y., by Popular Science Publishing Co., Inc. Godfrey Hammond, President and Treasurer; R. C. Wilson, Vice President; Raymond J. Brown, Vice President; F. W. Briggs, Secretary. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A. Copyright, 1940, by Popular Science Publishing Co., Inc. All rights reserved in the United States, Great Britain, and in all countries participating in the International Copyright Convention and the Pan American Copyright Convention. Single copy, 15 cents; Canada, 20 cents. Yearly subscriptions to United States and its possessions, \$1.50; Canada, \$2.00; foreign countries, excepting Canada, \$2.50. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, Popular Science Monthly does not underwrite the business methods of the individuals or concerns producing them. To avoid liability for patent infringement, readers should investigate before making, using, or offering for sale any of the devices, machines, or processes described; Popular Science Monthly takes no responsibility. The use of Popular Science Monthly articles for stock-selling schemes is never authorized.



Alone and penniless, armed only with the ideas that filled his brain, he challenges the world—determined to wrest success from the grasp of the great city.



Romance enters his life when he meets lovely Mary Stillwell... but instead of interfering with his work, it helps him forge ahead... with a new will to succeed.



Soon he invents the stock ticker. For it he receives \$40,000, though he would have taken \$2,000! His first success—his first step toward fame and fortune!

With a Dime and a Dream... HE CHANGED THE WORLD!

HIS LIFE was a wild adventure... though he spent most of it in a littered laboratory. Never did a man work so hard—fail so often—and succeed so brilliantly!


The whole astounding story is told by Metro-Goldwyn-Mayer in "Edison the Man"—the drama of an adventurous, inventive mind eager to grapple with any untried idea—and the human story of a warm-hearted man, his love, his kindness, his wit, his jolly, genial delight in his friends.

Spencer Tracy plays the role of Edison magnificently. Again this gifted artist presents a fine and true screen characterization—the most demanding of his career. This is one of the important pictures of our time—don't miss it!



Spencer **TRACY** AS **EDISON** **THE MAN**

A CLARENCE BROWN Production
with RITA JOHNSON • LYNNE OVERMAN
CHARLES COBURN • GENE LOCKHART
Henry Travers • Felix Bressart

Directed by CLARENCE BROWN
Produced by John W. Considine, Jr.
Screenplay by Talbot Jennings and
Bradbury Foote
 A Metro-Goldwyn-Mayer Picture



9,000 failures! They called him a fake—a charlatan. But he believed in his dreams! He knew that he could grapple with the mystery of the electric light—and win!



The dynamo explodes! Five hours left to light the city—or be branded a failure forever! "We can change the world in five hours!" shouted Edison—and he did!

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In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

The Ford Good Drivers League Nation-wide Driving Contest for Boys of High-school Age

\$30,000.00 in Prizes!

Consisting of 48 University Scholarships

96 Free Trips to N. Y. World's Fair

Championship Cups to State and National Winners

Beginning at once—ending August 29 at the World's Fair in New York, when the Champion High-school Age Driver of the United States will be selected from the 48 State Winners.

★ FIRST PRIZE

University Scholarship of \$5000 and Championship Cup.

★ SECOND PRIZE

University Scholarship of \$2000 and Runner-up Cup.

★ NEXT THREE PRIZES

University Scholarships of \$500 each.

★ NEXT EIGHT PRIZES

Scholarships of \$250 each.

★ NEXT THIRTY-FIVE PRIZES

Scholarships of \$100 each.

Each of the 48 State Winners will be given a Free Trip to the New York World's Fair for himself and a parent or other sponsor of his own choosing, with expenses paid both ways and during the five days in New York when the final contest is held. (For contest purposes, the District of Columbia is included with Maryland.) State Championship and Runner-up Cups will also be awarded. In case of ties, duplicate prizes will be awarded.

● Become a League Member

Any boy is eligible for membership (1) who is a resident of the United States, (2) who is qualified and legally authorized to drive a car in his home state, (3) who is at least 14 years of age, (4) whose 19th birthday is not earlier than Aug. 29, 1940. The make of car owned or driven by an entrant or his family does not matter. The League is for all boys eligible under the four requirements stated above.

All that is necessary is to fill out and sign an Enrollment Blank which you can obtain from any Ford, Mercury or Lincoln-Zephyr automobile dealer. If you are unable to obtain

an Enrollment Blank from the dealer, write directly to the Ford Good Drivers League, Dearborn, Michigan.

Read the blank carefully. It contains a Pledge of Careful and Courteous Driving, which must be signed before you will be accepted as a member. There are no dues or fees to pay—no obligations of any kind except to live up to your pledge of good driving. Mail your Enrollment Blank to the Ford Good Drivers League, Dearborn, Michigan.

● Enter this Contest

As soon as your Enrollment Blank is received, you will be sent a Membership Card, a lapel Membership Button, and a copy of the League's new 64-page book, "How to Become a Skilled Driver," by Ray W. Sherman.

You will also receive immediately full details and Entry Blank for the Nation-wide Driving Contest to which only members of the Ford Good Drivers League are eligible.

The State Elimination Contest requires:

1. The answering of questions based largely on the new book, "How to Become a Skilled Driver."
2. A letter of not more than 300 words, on "What I Can Do Personally to Reduce Automobile Accidents."
3. A 25-mile driving test, scored by a competent adult observer.

All contest material must be mailed to the Ford Good Drivers League on or before midnight, July 10, 1940.

The Board of Judges for both state and national contests will be: J. Stannard Baker, National Safety Council; Elmer P. Grierson, Pub-

lisher of The American Boy; Louis R. Morony, Executive Director, American Association of Motor Vehicle Administrators; Dr. F. R. Noffsinger, Educational Consultant, American Automobile Association; Ray W. Sherman, author.

● National Finals at New York

This will be a notable occasion. Each of the winners from the 48 States will arrive in New York with his sponsor in time for registration Monday forenoon, August 26. They may travel to New York either by train or automobile. In either case, an amount equal to train fare and pullman both ways, plus an allowance for meals, will be paid by the League for both contestant and one sponsor. In New York, both will be guests of the League for five days.

On the afternoon of August 26, there will be a parade of State Champions. Cars for this and final driving tests will be furnished by the League.

On Tuesday and Wednesday the Contest Finals will be held. Contestants will be judged on:

1. Day and night driving.
2. Maneuver operations, such as parking, braking, clutching, etc.
3. Physical reaction tests, including vision.

Upon the results of these practical tests, the judges will select the National Champion and Runner-up and will award all scholarship prizes.

● The Banquet of Champions

On Thursday evening, August 29, these awards will be announced at the League's First Championship Banquet in New York City. Edsel Ford, President of the League, and members of the Honorary Board are scheduled to be present.

On Friday there will be a visit to Radio City for all contestants and their sponsors, a luncheon with prominent sports stars as guests, a big league baseball game, and a visit to the World's Fair at night.

Join the Ford Good Drivers League now and become eligible for this contest. Read again the requirements and mail Enrollment Blank to

FORD GOOD DRIVERS LEAGUE

DEARBORN
MICHIGAN

Edsel Ford PRESIDENT



...but **GUESSWORK** is far from funny in motor repairing. Play safe. Get piston rings that are specifically *Engineered* for your particular model of car.

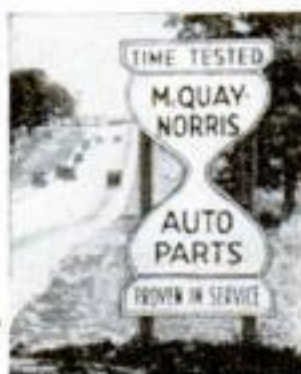
Insist on
McQUAY-NORRIS
 ALTINIZED
Engineered Set
PISTON RINGS



ENGINEERED SETS are specially designed for each make and model of car and *precision installed* according to blueprint instructions. There's no guesswork. That's why these rings

will stop oil waste and prevent blow-by in *your car*. And each ring is *Altinized* — an exclusive McQuay-Norris feature — to assure long life and minimum wear.

McQUAY-NORRIS MFG. CO.
 St. Louis, Mo.



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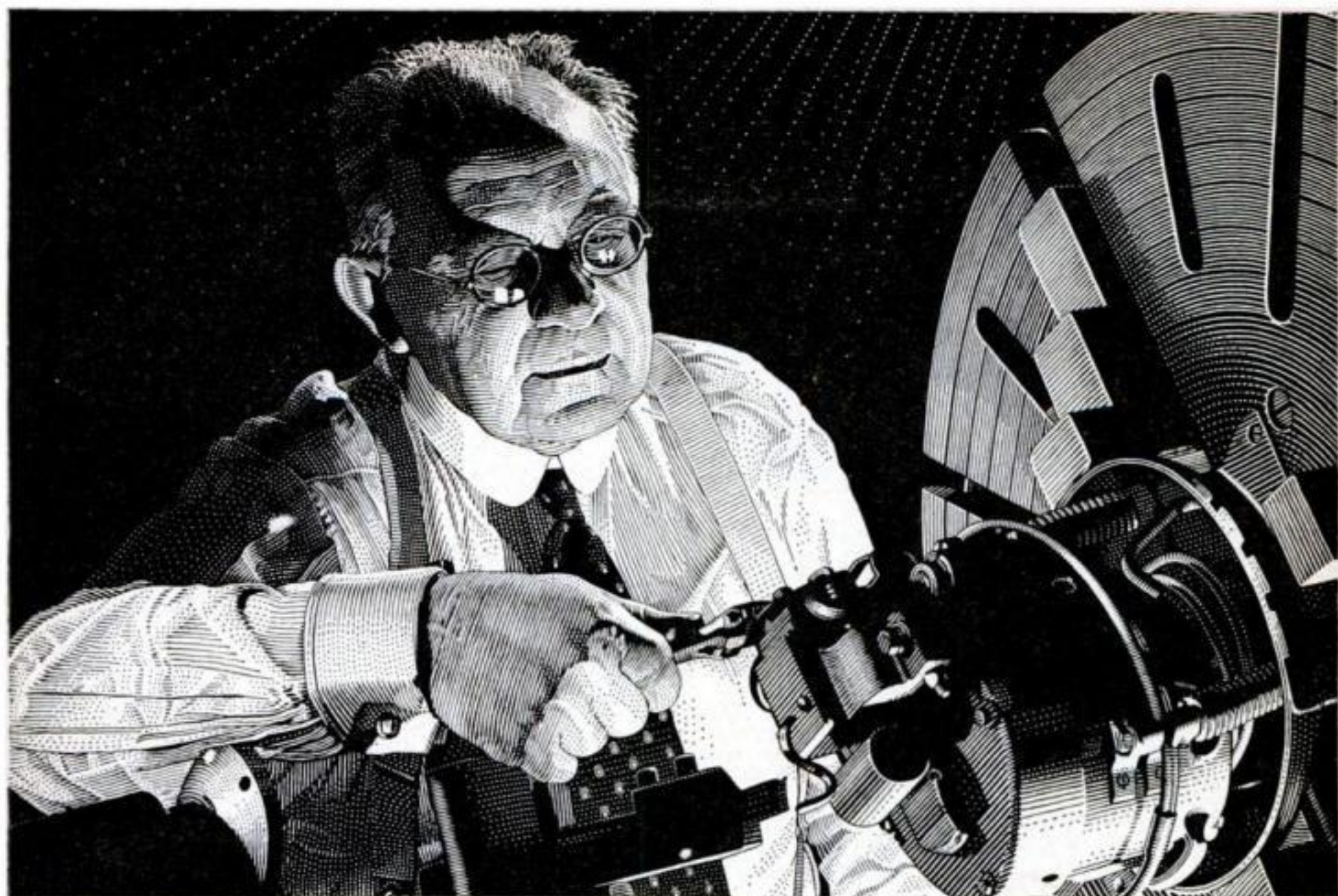
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THE STORY OF STEENSTRUP

IN 1901 a young Danish toolmaker began work in the General Electric shops in Schenectady. One day he hit on an idea for making a machine safer and more efficient. The boss had his doubts, but Chris Steenstrup proved his idea would work. Today, beloved by his fellow engineers, with 110 patents to his credit, Chris is still looking for ways to improve things.

Chris welcomes tough engineering assignments. For instance, he solved one of the toughest problems in the building of Dr. Alexanderson's great radio alternators which made possible radio communication with Europe during the World War. Back when there were very few domestic electric refrigerators in the country, Chris got the job of devising a long-lived

and efficient refrigerator. After months of work he designed a mechanism that ushered in a new era in American living. For from it General Electric developed the first sealed-in-steel refrigerator mechanism—the principle that has helped bring the comforts of electric refrigeration to 14 million American families.


Chris Steenstrup's contributions to more comfortable living are typical of the hundreds made by General Electric men and women. For years they have been putting electricity to work in the home and in industry, helping to make all manufactured products more plentiful and less expensive, enriching our lives—providing More Goods for More People at Less Cost.

G-E research and engineering have saved the public from ten to one hundred dollars for every dollar they have earned for General Electric

GENERAL  **ELECTRIC**

90-226E2

**LUCKY DAY FOR
ME WHEN I
FOUND OUT THAT
THE GILLETTE
TECH RAZOR
MAKES SHAVING
A BREEZE**



**FRED PERRY, International Tennis
Champion**

Millions Of Men Now Enjoy Shaving Speed And Comfort Never Experienced Before

FOR SHAVES worth telling your friends about, get acquainted with Gillette's new Tech Razor. "There's no discomfort . . . no nicks or cuts," says Fred Perry. "Easiest-shaving razor I ever used," agrees Coach Crowley. "Bucky" Walters, Gene Sarazen and thousands of others say the same.

Sets Up Your Beard

The Tech has four basic advantages. One is the solid bar guard. This sets up your whiskers like a barber does, speeds shaving and prevents nicks and cuts.

Made For Each Other

Today's Gillette Blue Blade has edges of a new kind. They're sharper, longer lasting. And because these blades are made to fit your Gillette Razor exactly, they spare you all the smart and burn of misfit blades. Ask your dealer for the new Tech Razor and five Gillette Blue Blades. You pay only 49c . . . and satisfaction is guaranteed.



**NO TROUBLE GETTING GOOD
LOOKING SHAVES IN A JIFFY
WITH THE NEW TECH RAZOR
AND GILLETTE BLUE BLADE**

**JIM CROWLEY, Head Football
Coach, Fordham University**

FOUR BIG IMPROVEMENTS

- 1** SOLID BAR GUARD ASSURES COMFORT
- 2** CLEANS QUICKLY—NEVER CLOGS
- 3** NON-SKID TREAD PROTECTS FACE
- 4** RIGID BLADE SUPPORT SPEEDS SHAVING



**TECH RAZOR
AND FIVE
GILLETTE BLUE
BLADES**

49¢



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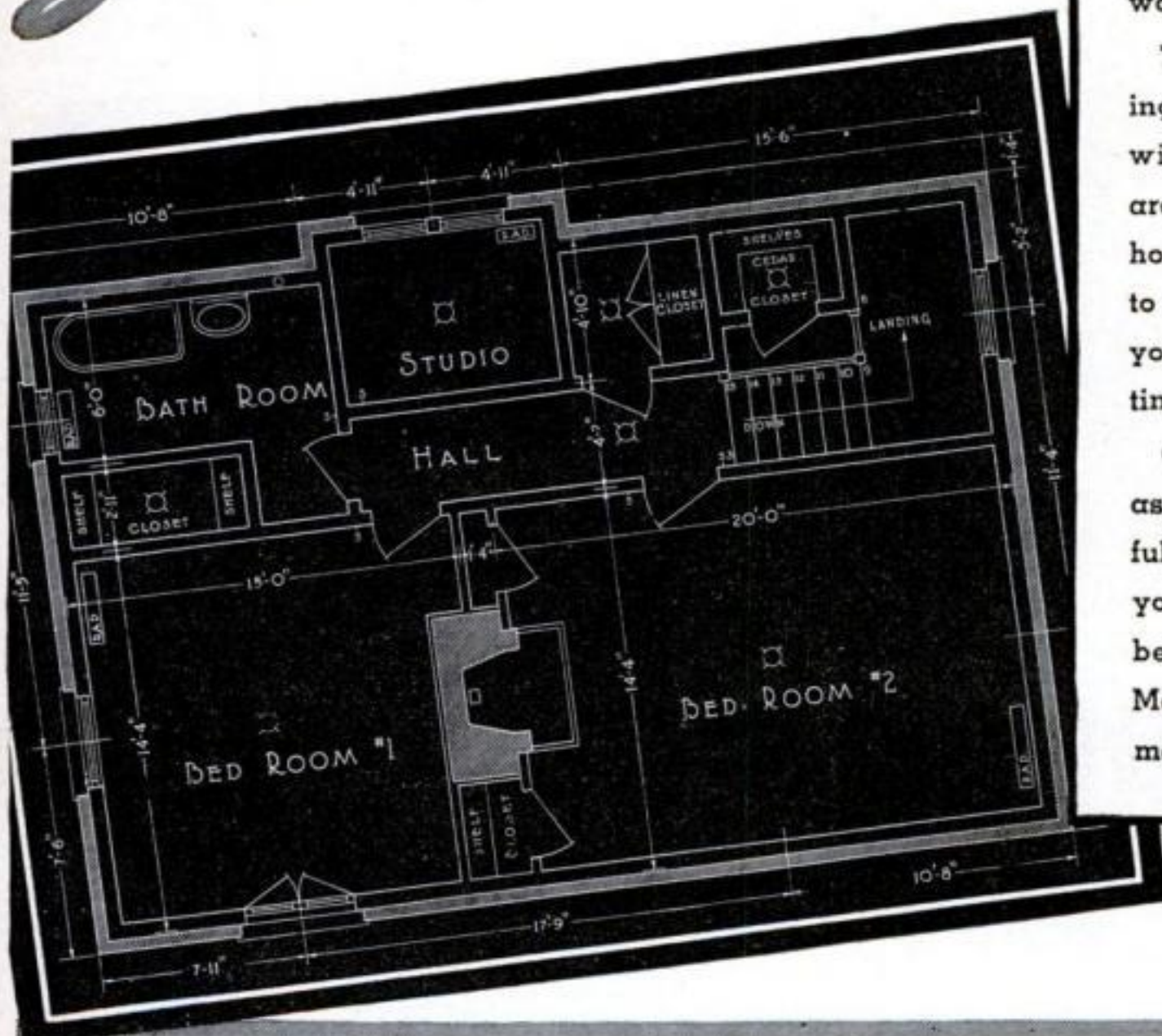
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can you find 5 ERRORS in this print



SOME of the errors in this print are obvious. But it takes a trained man to read blueprints satisfactorily—or to get ahead in a complex, specialized world such as ours!

The man without training is usually the man without money. Look around, and you'll see how true that is. It's up to you to get the training you need, while the getting's good!

Get it "the I.C.S. way," as thousands of successful men have done. Fit yourself for a bigger, better paying position. Mail this coupon—not tomorrow, but now!

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★ Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course *before* which I have marked X: ★

TECHNICAL AND INDUSTRIAL COURSES

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| <input type="checkbox"/> Air Conditioning | <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Mechanical Drafting | <input type="checkbox"/> Sanitary Engineering | <input type="checkbox"/> Sheet Metal Work |
| <input type="checkbox"/> Architectural Drafting | <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Fire Bosses | <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Steam Electric | <input type="checkbox"/> Steam Engines |
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| <input type="checkbox"/> Auto Engine Tune-up | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Navigation | <input type="checkbox"/> Structural Engineering | <input type="checkbox"/> Surveying and Mapping |
| <input type="checkbox"/> Auto Technician | <input type="checkbox"/> House Planning | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Patternmaking | <input type="checkbox"/> Telegraph Engineering | <input type="checkbox"/> Textile Designing |
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| <input type="checkbox"/> Bridge Engineering | <input type="checkbox"/> Managing Men at Work | <input type="checkbox"/> Manufacturing of Pulp Paper | <input type="checkbox"/> Plumbing | <input type="checkbox"/> Woolen Manufacturing | |
| <input type="checkbox"/> Building Estimating | | | <input type="checkbox"/> Poultry Farming | | |
| <input type="checkbox"/> Chemistry | | | <input type="checkbox"/> Practical Telephony | | |
| <input type="checkbox"/> Civil Engineering | | | <input type="checkbox"/> Public Works Engineering | | |
| <input type="checkbox"/> Coal Mining | | | <input type="checkbox"/> Radio, General | | |
| <input type="checkbox"/> Concrete Engineering | | | <input type="checkbox"/> Radio Operating | | |
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| | | | <input type="checkbox"/> R. R. Section Foreman | | |

BUSINESS COURSES

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| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> College Preparatory | <input type="checkbox"/> Commercial | <input type="checkbox"/> Foremanship | <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Service Station Salesmanship |
| <input type="checkbox"/> Business Correspondence | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> C. P. Accounting | <input type="checkbox"/> French | <input type="checkbox"/> Sign Lettering | <input type="checkbox"/> Spanish |
| <input type="checkbox"/> Business Management | | | <input type="checkbox"/> High School | <input type="checkbox"/> Traffic Management | |
| <input type="checkbox"/> Cartooning | | | <input type="checkbox"/> Lettering Show Cards | | |

DOMESTIC SCIENCE COURSES

- | | | |
|---|---|---|
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria |
| <input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Professional Dressmaking and Designing | <input type="checkbox"/> Management, Catering |

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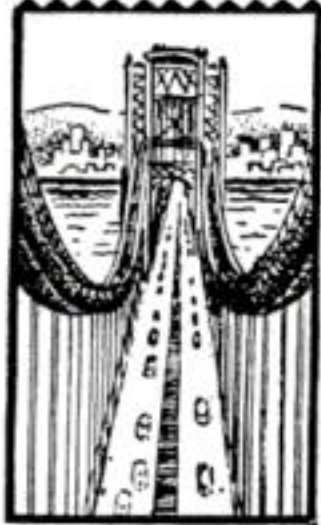
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Our Readers Say



It took a Lot of Hunting, Then It Turned Up in P. S. M.

THREE years ago, my husband was stricken ill. Today, though he is improving steadily, he is quite inactive as a result. From manual labor, he has had to turn to something that required only the mind and hands. It has taken a lot of hunting to find something to make "time fly," and at the same time something that could be adapted to our limited working space and budget. He has built model airplanes of all descriptions, boats, autos, and trains, over and over, and was becoming quite bored with the monotony, when along came the February *POPULAR SCIENCE*. After scanning the article "Toothpick Engineering Is Dentist's Hobby," for an hour, he finally laid the book aside for a minute and said: "Now why can't I do that!" He has spent nearly two weeks hunting pictures, studying them, and making drawings from which to work. I have bought boxes of toothpicks. Time passes more pleasantly for him, and our home is more cheerful these days, because of that article. Won't more folks with interesting, economical hobbies of this type let other folks in on them?—Mrs. E. B., Detroit, Mich.

But You Can't Make a Horn Say: "Whereyathinkyergoinanyway!"

SOME of the new cars have turn-indicating lights that the driver can switch on at will to warn motorists behind him and in front of him that he is going to turn right or left. That's surely a swell idea. But as a motorist of long experience, I've always wondered why a code of driving signals hasn't been promoted by some national car association to permit drivers to "talk" to each other with their horns, much the way railroad engineers do with their whistles. One toot, for example, could be just a warning signal. Two short ones could advise others you're about to turn right; three short ones left. Borrowing the dot-dash system, a dot-dash could mean you're about to back up; a dash-dot to start forward. Objection might be raised to the noise. Well, most cars have double horns now anyhow. They could be wired so that only a single, soft tone would be employed for this type of signaling. How about it?—W. D., Washington, D. C.

TRY AND DO IT WITH
JOHNNY-ONE-NOTE
VIRTUOSOS



(Continued on page 14)

Wants Instrument Panels for Pavement Pilots

WHENEVER I see a picture of the cockpit of a big plane, with its huge panel of meters and gauges, it makes me green with envy. I'm a nut about precision instruments. If I drove a car, I'd have it loaded down with all the gadgets I could buy, but as it happens I don't even ride a bicycle. So why not an instrument panel for pedestrians, to give fellows like me a break?

I would suggest a compass, pedometer, altimeter (which could also serve as a barometer for weather observation), hygrometer, and an instrument for determining velocity and direction of the wind. Perhaps a bank-and-turn indicator would be handy in some cases. All these could be mounted on a panel supported by a yoke around the user's neck, with a rear-view mirror attached.—D. M., St. Paul, Minn.

A Little Light Exercise for the Radio Experts To Reflect Upon

HERE is a problem for some of your radio bugs. Of course, you know what kind of a noise a radio makes when a vacuum cleaner is running near-by. Well, I used to have to shut off our radio when our cleaner was on. One day I found that by turning on a powerful 300-watt lamp, the interference was almost eliminated. How come? Can anybody help me?—G. A., Salina, Kans.

HECK, JUST TURN
OFF THE VACUUM
CLEANER!



The Little Man Who Wasn't There —Against a Black Background

ALTHOUGH I have been receiving your magazine only a few months now, I have become very interested in several sections, particularly "Readers Say." In answer to C. M.'s question on page 116 in January's issue, I would suggest that he take a closer

How Big Is YOUR PAY-CHECK?

*If you earn under \$3,000,
Higher Accountancy may
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"THE size of my pay-check? What business is it of yours?" Perhaps that's the first reply that comes to your mind.

But—stop a moment. It really *is* our business—to help men just like you. In fact, it's been our business here at LaSalle for 30 years.

If your pay-check isn't all that you'd like it to be, why not consider accountancy? Why not become a member of this well-paid and respected field? Why not, in short, prepare yourself to earn real money—insure a good home for your family—a new car—an education for the growing youngsters—a bank account for a rainy day . . . these and many more of the precious things in life?

Maybe you're one of those ever hoping for "breaks" that will give you a higher standard of living. Yet that's precisely what most of 30,000,000 other employees in this country are doing.

Not all of them, of course. Here and there you find ambitious men who aren't depending on luck to carry them ahead. They're following a tested path to increased earnings—leaving nothing to mere chance. They're *training* themselves for better jobs—every week spending a few hours in serious but interesting study at home.

Some day, as expert bookkeepers and later as accountants, these determined men will have standing and a considerably larger income—in a profession that pays and pays well.

Why don't *you* do as they are doing—take advantage of LaSalle training? Even though you do not know the fundamentals of bookkeeping now—you nevertheless may have an excellent opportunity to master accountancy. Many others have done it.

Perhaps you're asking yourself, "But don't these others possess natural ability that I lack? Don't I need a special talent for all this?"

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Our Readers Say (CONTINUED)

look at the picture. The obvious reason for the head suspended in air is that the person is wearing a black suit and it is invisible against the black background. For proof of this, his shoes may be observed in the center of the front wheel of the bicycle. As for the feet in the right-hand corner of the picture, they may belong to the "little man who wasn't there."—R. H., Westfield, N. J.

It's a Matter of Definition —and Who the Girl Is

WHILE you're waiting for quitting time on a drowsy day, or waiting for a train or bus that's not due for an hour, does the time pass fast or slow? I maintain that it seems to pass fast. Look. While you're waiting, you note that it's, say, two o'clock. You wait and wait, then say to yourself that it must be two-thirty, but when you look at your watch, it's only two-fifteen. Thirty minutes seemed to have passed in only fifteen. If that doesn't mean time has seemed to fly, then what does it mean? P.S. This holds true in reverse with girl under moonlight.—J. R., Rankin, Pa.

G'WAN, ANY GIRL WILL
DO IN THE MOONLIGHT
AND TIME JUST AINT



He Says Hats Off to the Ladies and Let's Hear from 'Em Often

SHAME on the guys who probably haven't got the gumption to tell their wives what they think to their faces, and then write snide letters to the editor in which they say things that would justify homicide, or at least a one-way trip to Reno, if their wives ever got wise. Two such mugs sounded off in "Our Readers Say" in April. One complained because his

wife only thought about dresses while he attempted to explain what makes an airplane fly. The other growled because his wife wouldn't darn his socks for him even if she did have one of those new electric patchers. I noticed that on the same pages with this pair of letters were letters from Miss



I. B., of Kansas City, and Mrs. M. E. C., of Watertown, N. Y., and I doubt that it was an accident that the four letters were so close to each other. Each of the ladies had

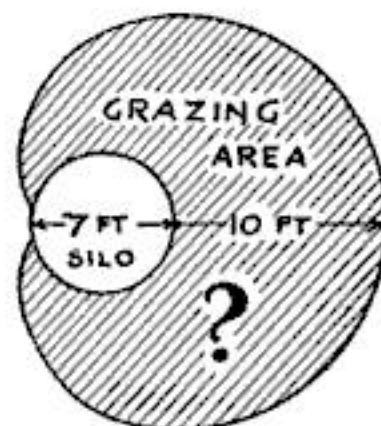
(Continued on page 16)

something positive and interesting to say. Each of the guys sounded off in the negative, and their palaver probably didn't create one iota of a stir anywhere but in their own superinflated egos. Hats off to the ladies, and let's have more letters from 'em. What's more, I swear my wife isn't looking over my shoulder while I'm writing this.—S. R., Akron, Ohio.

One Thing Leads to Another with These Mathematical Guys

THE answer to the coconut problem submitted by A. D. W., of Rensselaer, Ind., is exactly 3,121 coconuts. Just to get A. D. W.'s goat, I submit the following goat problem.

A goat is tied by a rope to a ring at the base of a silo. The base of the silo has an outside diameter of seven feet, and the rope allows the goat to reach a maximum distance of ten feet from the silo. The grazing area has no other obstruction than the silo. How many square feet of the grazing area can the goat graze upon? Give the area to the nearest hundredth of the remaining square foot.—B. H., Philadelphia, Pa.



Thinks the Age of Books Has Outworn Its Bindings

THE article in April on the bookbinder who uses cover materials appropriate to the subjects of the books set me thinking about what I'd bind my favorite books with. From there I went on to wonder why we have books in bindings at all in this modern age. They take up so much room and are, after all, fundamentally the same as the first one that ever came off a printing press. I've read about libraries keeping copies of newspapers on movie film, and I don't see why books couldn't be printed on film in the first place. You could get a "Gone-With-the-Wind"-size book on a very few feet of eight-millimeter film. It could be projected on the viewing screen of a small projecting unit that would fit in your lap, or on the arm of your chair. And you could keep a powerful lot of reading matter

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TODAY—

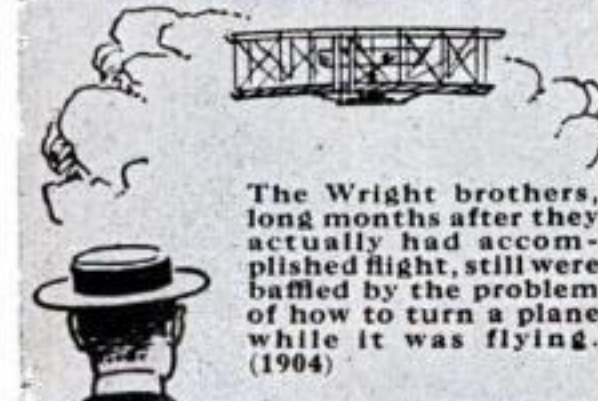
In 1940 . . . Schools of nursing require high school graduation because most of them are conducted at college level. Progress has made modern nurses' training equal or superior to that available to many old time doctors.



Thousands of schoolboys 14-16 years of age know more today about airplane design than the Wrights knew at Kitty Hawk.



The Wright brothers, long months after they actually had accomplished flight, still were baffled by the problem of how to turn a plane while it was flying. (1904)



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Alice in Wonderland learned: "You must run as fast as you can in order to stay where you are. To get anywhere, you must run **TWICE** that fast."

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Our Readers Say (CONTINUED)

in one small bookcase.—C. R., Cambridge, Mass.

If You Own a Circus, Here's a Great Idea for You

SOME time ago, a reader pointed out that no living creature had ever developed a screw propeller or a wheel, to aid its locomotion or for any other purpose. Just recently, an article in your magazine exposed numerous erroneous beliefs about snakes, one of them being the old myth of the "hoop snake" that is supposed to make a hoop of itself and roll cross-country at a great rate. It struck me at once that such a creature would be what the reader was talking about—a living wheel, and a pretty darn efficient one at that. I believe that some smart circus man would make his fortune if he *could* train a snake to become a rolling creature. In recent conversation in my region, I've gathered that there still are plenty of people who believe such snakes actually exist, your able article notwithstanding.—S. M., Charleston, W. Va.

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Who'd Think Playing Marbles Could Be So Complicated!

THAT was a highly interesting letter about the marble rolling on the turning record on a phonograph turntable. I immediately tried the experiment and confirmed A. G. K.'s observation that the marble stays put for a surprisingly long time. He wants to know why. So do I, but don't know enough math. I can, however, catalog the forces acting on the marble, leaving their analysis to some wiser person. They are: Inertia, momentum, gravity, and gyroscopic force. Assuming all conditions were ideal, I believe the marble would stay put indefinitely, provided the experiment were performed at the equator and with the marble's axis parallel to the earth's. But friction, and resistance to the air turbulence set up by the turntable, are factors that soon force the marble out of its state of dynamic equilibrium. Centrifugal force must now be added to our list as the marble slows down, as well as an inward or centripetal force as gyroscopic action tends to steer the marble inward again (as it starts backward). These little problems always present perplexing obstacles to a fair solution. Even if I could work out the formula expressing the condition of the marble, somebody would come along and remind me that I'd forgotten to consider the spiral

sound groove on the record. Well, they're fun anyway.—T. L., Albany, N. Y.

Brain Currents Are Needed To Dope This One Out

INSULATING materials like rubber, glass, and porcelain, are compounded of elements which according to the atomic theory are made up of minute bodies called electrons and protons. Any physicist will tell you that electrons and protons are negatively and positively charged parts of each atom. Now, these are electrical by origin, and yet they cannot conduct electricity in the above substances. What is the answer to this paradox? If any reader knows the scientific answer, I hope you'll be good enough to give him a little space in "Our Readers Say."—C. C., Meycauayan, Bulacan, P. I.



YA GOT SOMETHIN' THERE!



Hardly Constructive Criticism, But Somehow We Like It

THERE'S one criticism I would like to make about your magazine: It's entirely too popular. The minute it arrives, I have to spend my time beating off others in my house so I can get at it myself.—A. A., Oak Park, Ill.

Locomotive Engineer Would Flag Down Reckless Motorists

As I am a locomotive engineer, my duty calls me over many miles of track through all kinds of country. Our company teaches and talks "safety first." While our records show we are speeding up, we are doing it with safety as the first rule. Our examinations are to the point and strict. Our laws are enforced. Now why can't we as automobile drivers be forced to take similar safety examinations, learn about the cars we drive, and learn the safety rules, as we do on the railroad? If railroad men can't pass such tests, they don't work for the railroads. I've seen many auto accidents. What impresses me is the fact that the average person thinks lightly of them until they strike within his own family. Then?—D. A. M., Carthage, N. Y.

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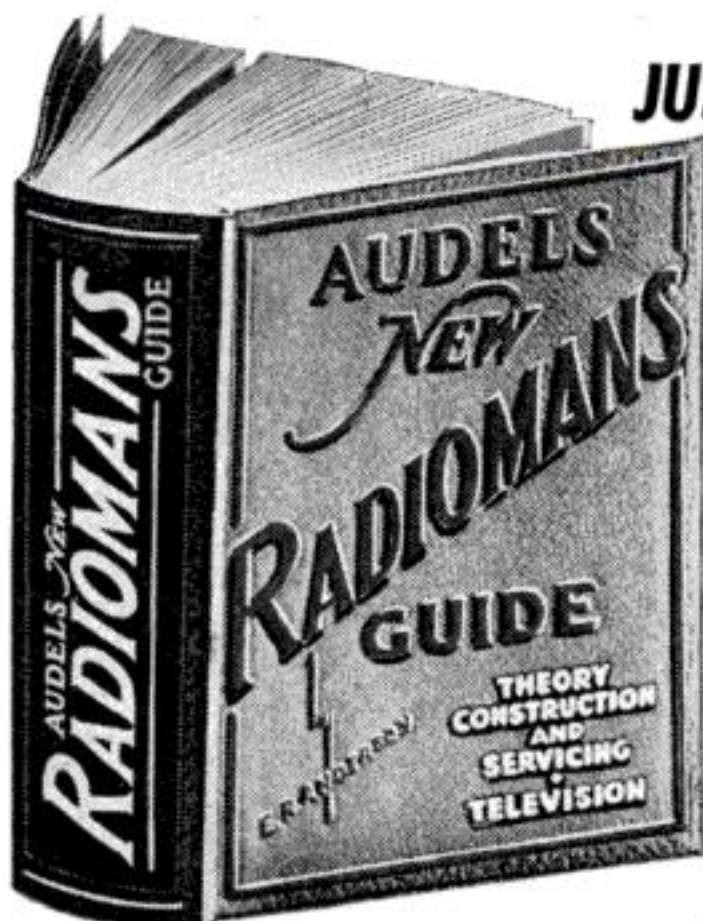
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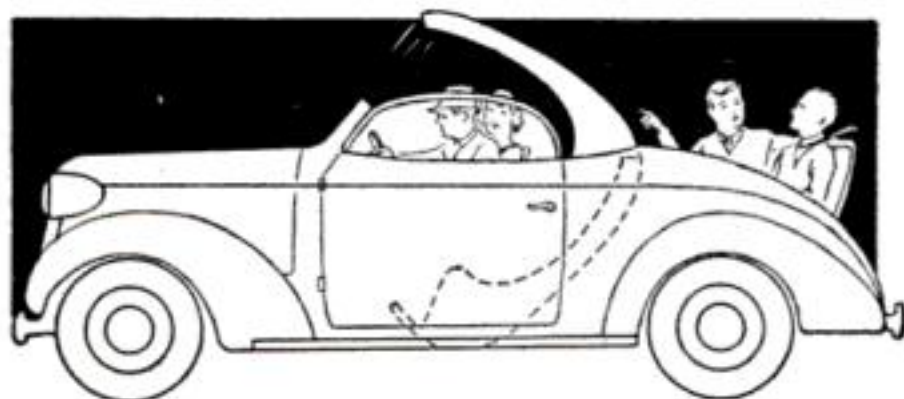
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With the Inventors

AUTOMATIC TOPS for convertible coupes, that open and close at a touch of a button, are well known to motorists, but an automatic top that has the strength of the top of a closed coupe is incorporated in the design worked out by Jack M. Atwater, of New



York City. It is pointed out that if a car equipped with such a top should turn over while the top were up, closed-car security would be assured for the driver and his front-seat companions. Made of solid steel, the top rolls back on tracks at the touch of a convenient dashboard button into a curved recess or well that extends under the seat of the car. When the top is raised, its front edge locks securely to the top edge of the windshield frame . . . NO TRADE MARK may be registered that "comprises the flag or coat of arms or other insignia of the United States." . . . MOWING THE LAWN SHOULD BE more of a pleasure and less of a chore with a novel gasoline-powered tricycle mower de-



veloped by William Walker Gore, of Hewett, W. Va. Fitted with a saddle and handlebars for its operator, the three-wheeled mower is powered by a gasoline engine mounted between the two front wheels. The mower is easy to maneuver around trees and shrubs, has a built-in grass catcher, and is equipped with an adjustable cutter for trimming the

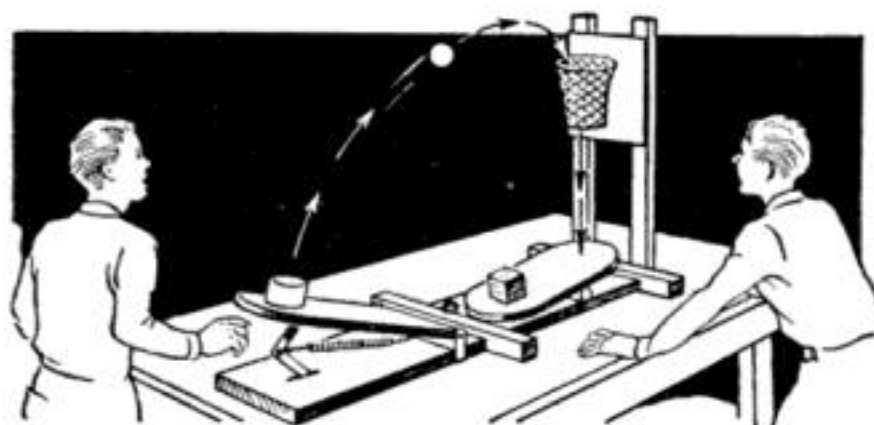
grass long or short . . . A CITIZEN OF FRANCE, GERMANY, or any other foreign nation may obtain a patent in this country on the same terms and conditions as a citizen of the United States . . . MANY A CHARRED TABLE,

(Continued on page 22)

burned carpet, and curtain fire in the home can be traced to a lighted cigarette that has rolled off its place on an ash tray. For this reason, Harold S. Williams, of Oak Park, Ill., has invented a magnetic device to hold a cigarette or cigar to an ash tray so that there is little danger of its falling off in case it is forgotten. A metallic band is slipped over the cigarette near its tip, so that a magnetized support attached to an ash tray will hold the cigarette firmly in place. The metal cigarette band may be applied during the process of manufacturing the cigarette, or it may



be furnished separately and slipped into place by the smoker . . . ONCE THE DETAILS of an invention have been filed in a Patent Office application, no new material may be added at a later time . . . TABLE BASKET-BALL IS THE NAME given to a novel game worked out by Michael E. Minger, of Pottsville, Pa. A ball is placed in a cup fastened to a spring-operated board serving as a catapult. When a player presses down and then releases the catapult, the ball sails through the air in an arc toward a miniature basket mounted on a vertical back-board. If it successfully passes through the basket, the ball drops onto the uppermost end of a second board which is mounted



like a seesaw. The weight of the falling ball tilts this board, flipping from its other end a die marked with game directions indicating fouls, penalties, the score made, or loss of the ball . . . AN INVENTOR WHO TAKES OUT an English patent is protected only in

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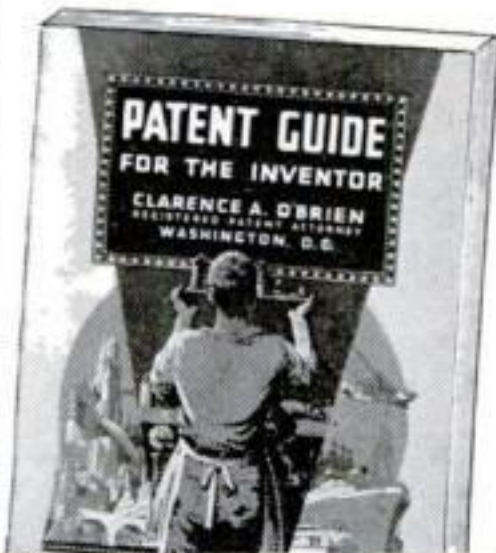
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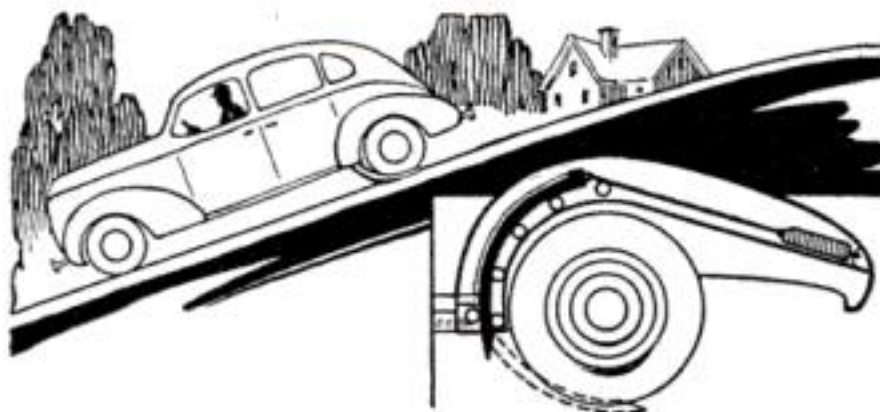
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With the Inventors

(Continued from page 20)

the British Isles and not throughout the British Empire . . . To **CHECK SKIDDING** on wet or icy roads, Ferdinand J. Buffa, of Brooklyn, N. Y., has invented a flexible mat that is built into an automobile fender so that it may be slid down in front of the



wheel. The mat, made of rubber reinforced with metal, is held by means of a spring in a trough built into the fender over the wheel. A cable fastened to a rigid shoulder at the back end of the mat leads to a control lever adjacent to the driver's seat. When this lever is pulled, the mat slides out of its trough and curves down under the wheel of the car, as shown by the dotted lines in the illustration . . . **QUERY: CAN A new combination of old elements be patented? ANSWER: Yes, if the combination produces a new result . . . RATS, MICE, AND OTHER VERMIN** have no chance to escape from an electric trap that is the invention of Clair T. Hazel, of Pleasant Gap, Pa. The trap is



plugged into an electric outlet, one wire leading to the metal base of the trap and the other to a bait hook and a wire ring surrounding it, both of which are fastened to a vertical wooden post. To reach the bait, the rodent must come in contact with the metal base. The moment it touches either the bait hook or the surrounding ring, its body completes the electric circuit.

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(Continued on page 24)



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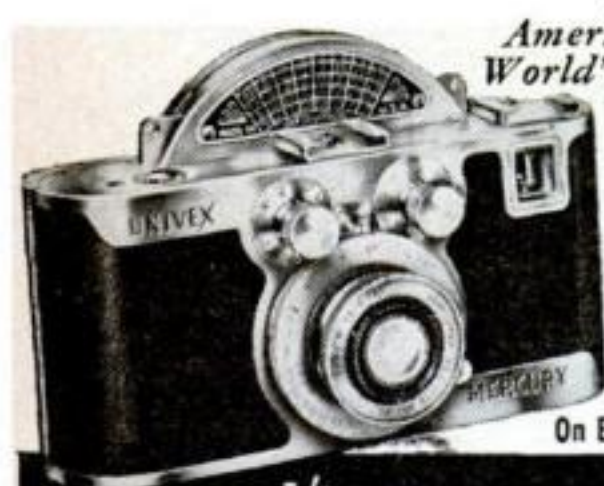
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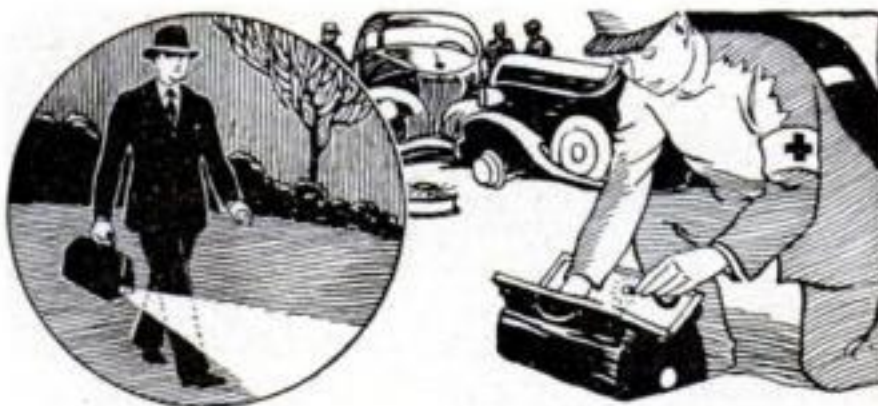
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With the Inventors

(Continued from page 22)

medical profession . . . THREE COMPLETE MEN'S SUITS can be hung in the space normally occupied by one, with a new triple garment hanger. Three individual wire hangers in the common triangular shape are connected together in a vertical row, with a metal tube reinforcing the bottom wire of the top and of the middle hangers. This is the invention of George L. Russell and Earl F. Lindahl, of Spokane, Wash. . . .

TITLES OF CHEMICAL PATENTS show no signs of getting any less complicated. Witness patent 2,193,788, issued recently: "N-Methylsulphites and N-Methanesulphinic Acid Salts of 1-Aryl-2,3-Dialkyl-4-Alkylaminopyrazolones." . . . AMBULANCE DOCTORS, general practitioners, salesmen, and others may welcome a novel satchel fitted with two lights, one to illuminate the interior and a second that shines out through a lens built into the side of the bag. A flash light installed in the bottom of the bag can easily be removed through an opening normally closed by a slide fastener, for bulb or battery replacement, or when it is desired to use the flash light separately. The flash light's regular bulb shines through the wall lens, while a second bulb connected to the flash-light batteries is mounted within and near the top of the satchel to light the in-



terior. The two bulbs are turned on or off by switches on the bag handle. When the satchel is closed, an auxiliary switch automatically breaks the circuit of the interior lamp, making it impossible to leave it burning inadvertently. Arthur H. Taylor, of Willimantic, Conn., is the inventor.

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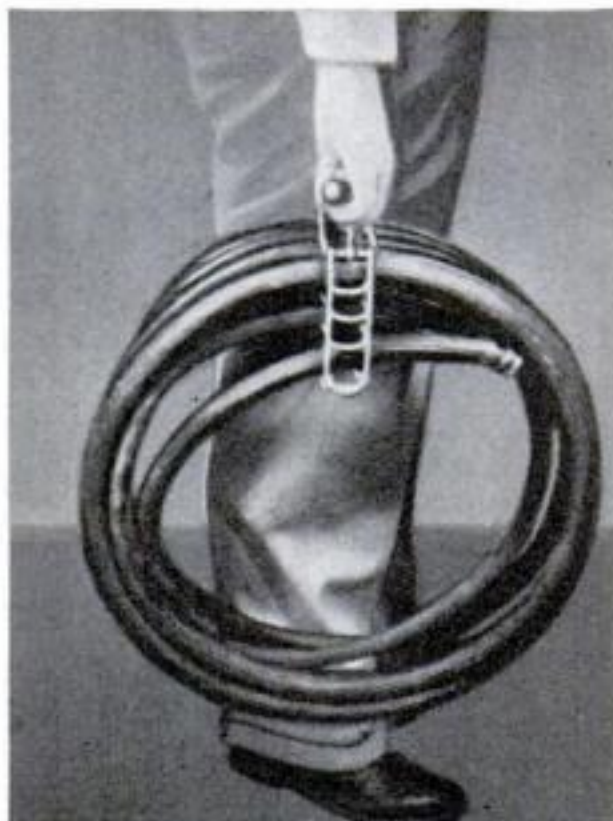


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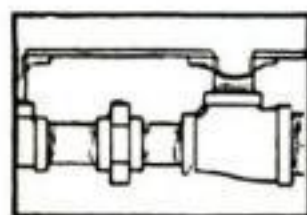


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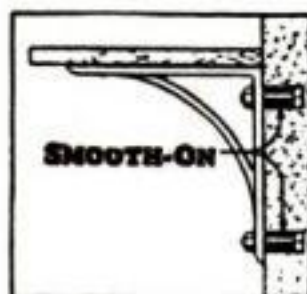
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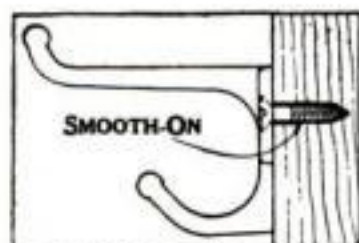
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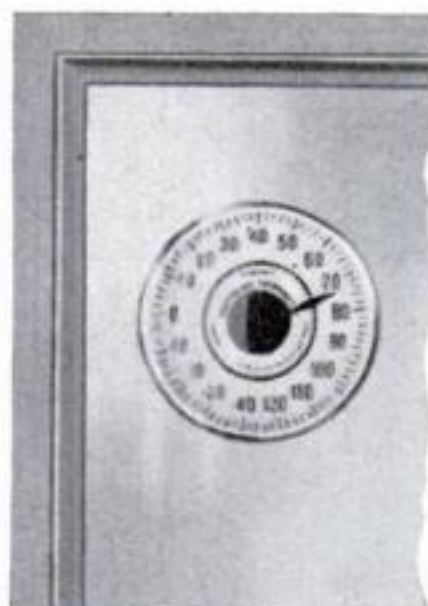
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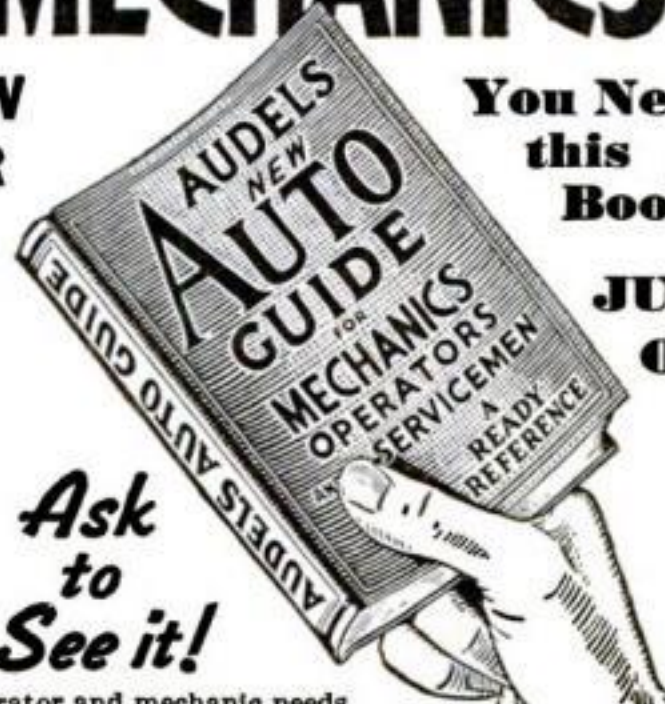
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A.—IF THE cracking is not too bad, it may be sufficient to wash it with a cleansing powder of the trisodium phosphate variety, sand-paper thoroughly, apply one coat of enamel undercoat and then one or two coats of good enamel. If the condition is very bad, however, the safest procedure would be to remove all old finish with liquid varnish remover down to the bare wood. Then clean it with denatured alcohol and steel wool, apply an undercoat, and a coat or two of enamel.

Paraffin as Wax Substitute

R. A., JEFFERSON CITY, MO. Melted paraffin makes an acceptable substitute for wax in covering and protecting grafts of fruit trees. The paraffin should be applied in the melted state, but not when very hot.

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Don't Transplant Them!

M. K., BALDWIN, N. Y. Horticulturists advise home gardeners to plant California poppy, sweet pea, and larkspur seeds in the spot where they are to grow and bloom, since transplanting of these flowers is hazardous.

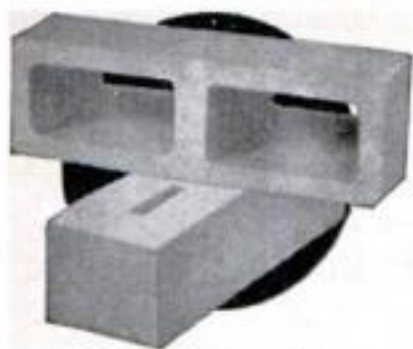
Radiator-Paint Problem

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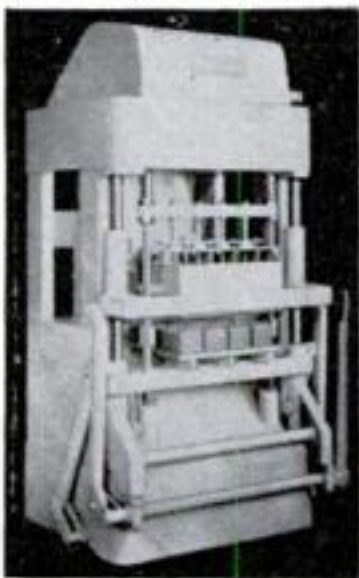
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FREE album and negative file, 2 enlargement coupons with each roll developed; 8 guaranteed prints 25c. Memrilane Studios, Dept. "Y", General P.O. 666, New York.

ROLL developed, 16 prints or 8 prints, 2 enlargements—25c. Wilson Studio, Hastings-on-Hudson, N. Y.

ROLL developed and printed, 2 enlargements, one in colors—all for 25c coin. Photo Finisher, Station E, Box 42-K, Columbus, Ohio.

TWO beautiful prints from each picture on roll 25c. Twenty years of satisfied customers. Quick service. Lens Photos, Dept. J-9, Janesville, Wis.

ROLLS developed—Two beautiful double weight professional enlargements, 8 Never Fade prints, 25c. Century Photo Service, LaCrosse, Wis.

IDEAL Photos beautifully finished with wide border, deckle edged; 25c per roll of 8 and Free enlargement. Ideal Photos, Box 2255, Paterson, N. J.

ROLLS developed, two prints each and two free enlargement coupons, 25c; reprints, 2c each; 100 or more, 1c. Summers' Studio, Unionville, Mo.

8 ENLARGEMENTS—films developed plus 8 enlargements, 25c coin—116 or smaller. Enlarge Photo, Box 791, Dept. PSM, Boston, Mass.

20 REPRINTS 25c, 100—\$1.00. Roll developed 16 prints 25c. 5 x 7 enlargements 10c. 3—25c. Nordskog, 58, Maywood, Ill.

ROLL film developed and 8 enlarged prints 25c. Enlarged Reprints .03c each. Pacific Photo Service, Box 666, San Francisco, Calif.

FIRST roll developed—Beautiful enlargement and 16 guaranteed prints, 25c. Dick's Photo, A-16, Louisville, Ky.

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FINER Double weight enlargements 5x7 3 for 25c. 8x10 3 for 50c. Lee Photos, P. O. Box 2053, Chicago.

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EXTRAORDINARY Halftones, offset negatives; also instruction, furnished. Imagic, Bristol, Tenn.

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QUICK Cash for your old coins. We pay big prices for wanted coins; certain 1909 cent, \$10; liberty head nickels before 1914 \$500; 1864, 1865 Indian head cents \$100 each; dimes before 1895 \$600; some worth \$6,000 each. Have you valuable coins in your possession? It will pay you to be posted—Send 15c for our illustrated coin catalog. National Coin Corporation, Uninc, (3), Daytona Beach, Florida.

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SONGWRITERS: Send your poem today for immediate consideration. Richard Brothers, 146 Woods Bldg., Chicago.

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UNITED States mixtures 35c lb. Canada 70c. Science, 4512 North Racine, Chicago.

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WATCH-REPAIRING is steady profitable work. Experts usually in demand. You can learn watchmaking trade at home, spare time. New original instruction system. Script engraving course included. Write for free details today! Nelson Company, F-2005 Manhattan Bldg., Chicago.

WATCHMAKERS' Materials; tools; watches; jewelry. Bought, sold, exchanged. Wholesale catalogue. Ben Segal Company, Mellers Bldg., Chicago.

WATCHMAKERS' Tools, supplies. Watch parts. Lowest prices. Write for price list 46. Dean Company, 87 Nassau St., New York.

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WELDERS, new and used. Write Lincoln Electric Company, Cleveland, Ohio.

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If you suffer with those terrible attacks of Asthma when it is hot and sultry; if heat, dust and general mugginess make you wheeze and choke as if each gasp for breath was the very last; if restful sleep is impossible because of the struggle to breathe; if you feel the disease is slowly wearing your life away, don't fail to send at once to the Frontier Asthma Co. for a **free trial** of a remarkable method. No matter where you live or whether you have any faith in any remedy under the Sun, send for this free trial. If you have suffered for a lifetime and tried everything you could learn of without relief; even if you are utterly discouraged, do not abandon hope but send today for this free trial. It will cost you nothing. Address

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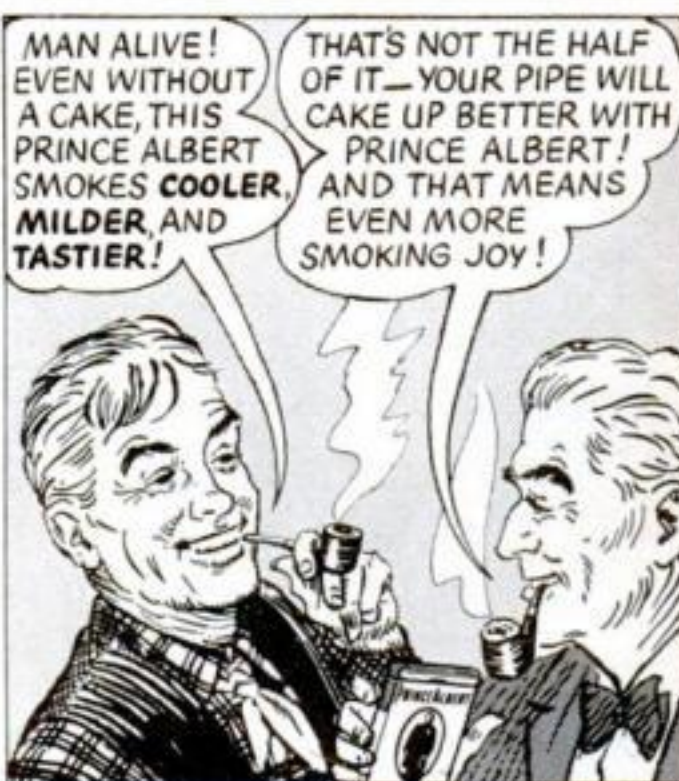
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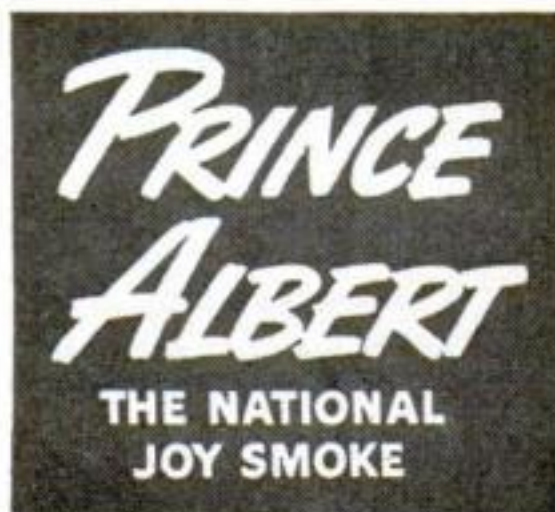


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pipefuls of fragrant tobacco in every handy pocket tin of Prince Albert



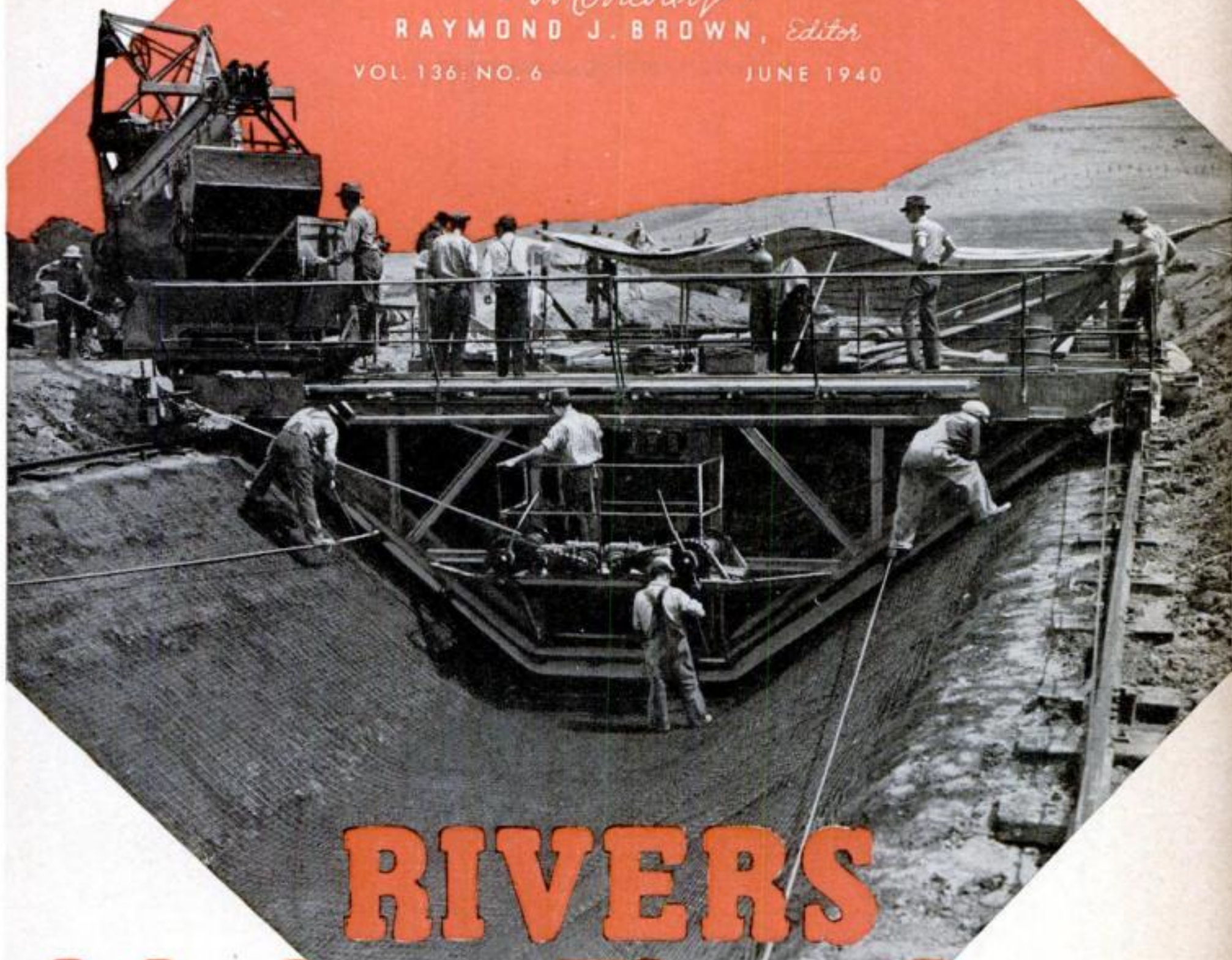
POPULAR SCIENCE

Monthly

RAYMOND J. BROWN, *Editor*

VOL. 136: NO. 6

JUNE 1940



RIVERS Made to Flow Over BRIDGES

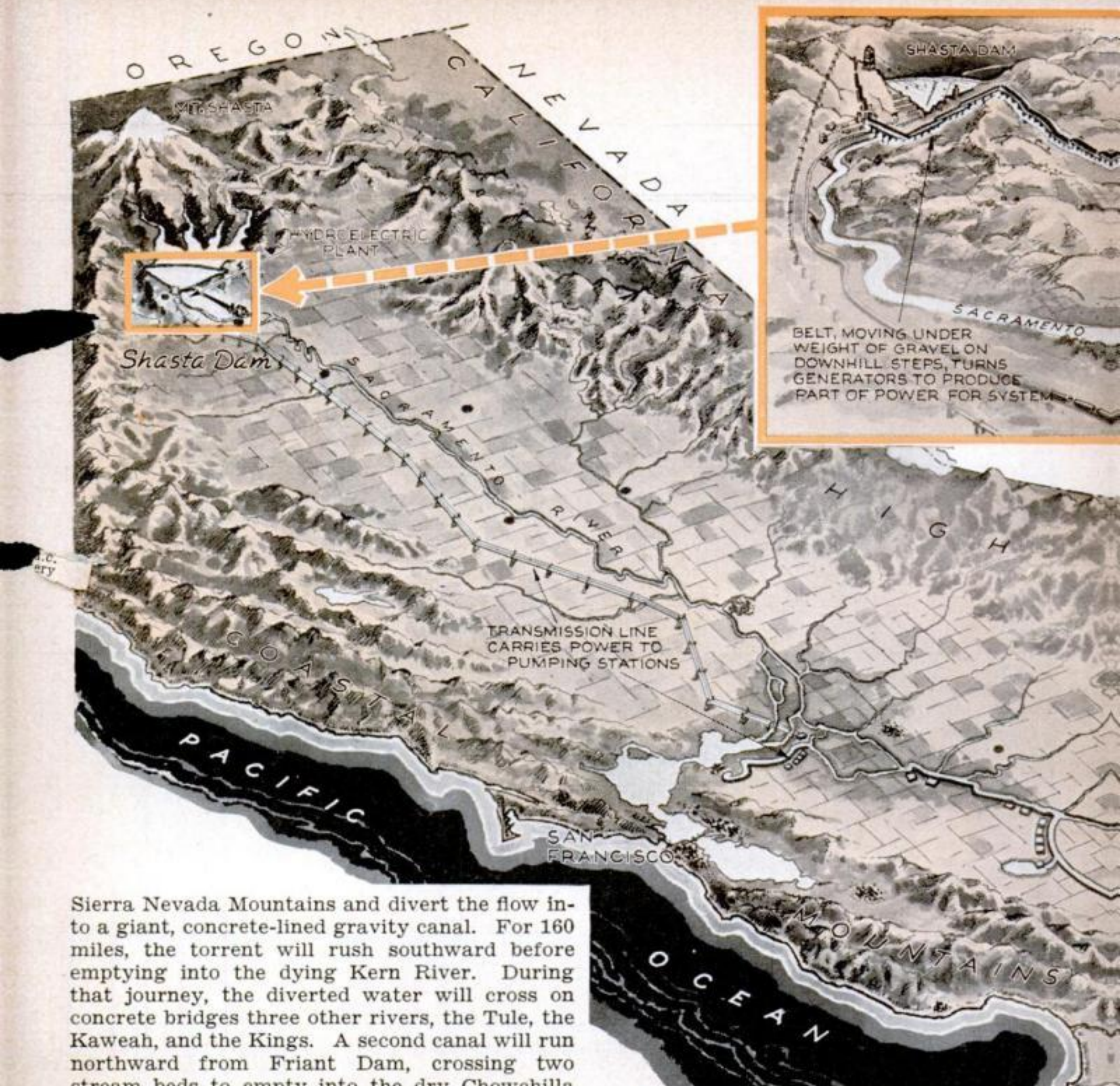
WITH concrete and asphalt, rock and steel, engineers are changing the map of central California. By recharting two river systems in the most complicated irrigation project of history, the U. S. Bureau of Reclamation plans to save a \$2,000,000,000 agricultural empire from the ravages of drought. Water from the Sacramento and San Joaquin rivers will be diverted into artificial beds; two great dams will function nearly 500 miles apart;

By
CHARLES F. BERRY

and fertile land, stretching half the length of the state in the vast trough between the Sierras and the coastal mountains, will receive needed moisture.

Paradoxes and superlatives characterize the gigantic project. Man-made rivers, for example, will flow over other rivers on bridges. Twenty miles from Fresno, Friant Dam, a 1,500,000-cubic-yard barrier of concrete, will cut off the waters of the San Joaquin River where it emerges from the

**WORLD'S STRANGEST IRRIGATION SYSTEM
TO PROTECT CALIFORNIA'S FARM LANDS**



Sierra Nevada Mountains and divert the flow into a giant, concrete-lined gravity canal. For 160 miles, the torrent will rush southward before emptying into the dying Kern River. During that journey, the diverted water will cross on concrete bridges three other rivers, the Tule, the Kaweah, and the Kings. A second canal will run northward from Friant Dam, crossing two stream beds to empty into the dry Chowchilla River, forty miles away. By keeping this stream flowing throughout the year, it will revive farm lands once famous for raisins, wine, and table grapes.

A stream running uphill for more than 150 miles is another paradoxical feature of the plan. A cross channel will divert part of the Sacramento's flow across sloughs into the mouth of the drained San Joaquin. Here, by means of pumping stations and collapsible dams, the water will be forced up empty river beds and through man-made canals until it reaches a point sixty-two feet above its starting point and more than 150 miles away. From here, the misplaced stream will slip twenty-three miles by gravity to rejoin the San Joaquin's bed at Mendota.

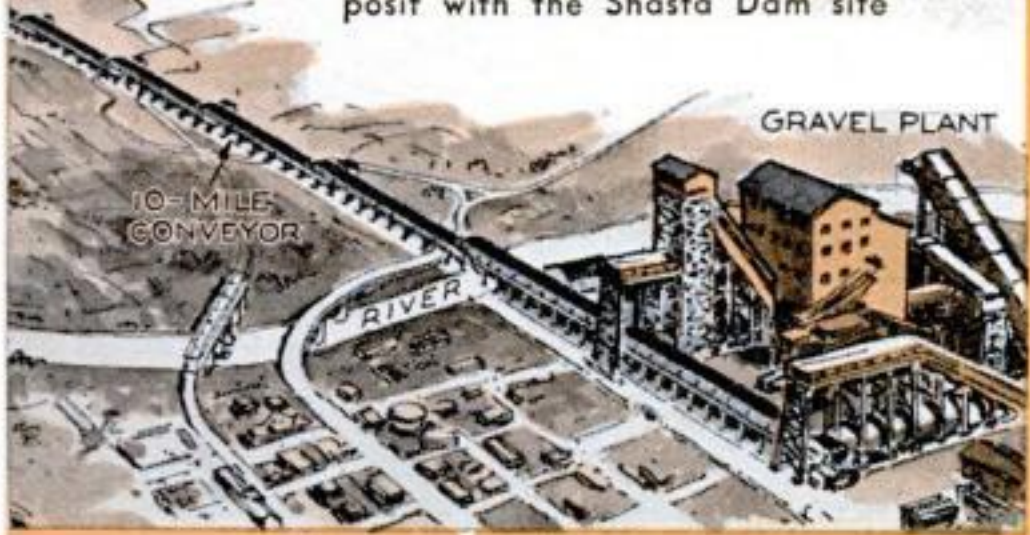
At the northern end of the Central Valley,

BELT, MOVING UNDER WEIGHT OF GRAVEL ON DOWNHILL STEPS, TURNS GENERATORS TO PRODUCE PART OF POWER FOR SYSTEM.

TRANSPLANTING RIVERS IN A VALLEY EMPIRE

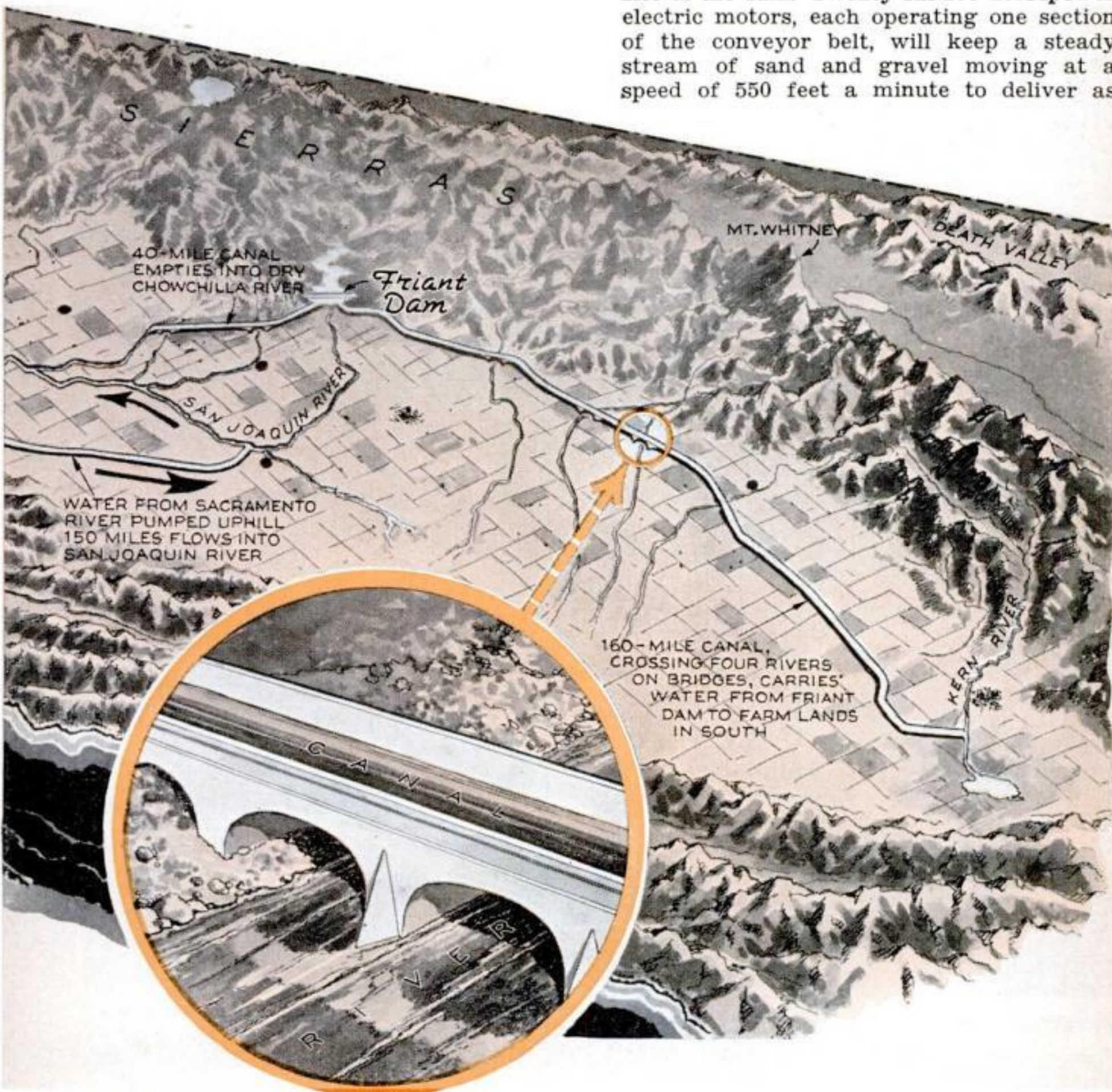
Details of the vast irrigation project undertaken for the Central Valley of California. In the circle, how its canals will span natural streams on bridges

More than twenty miles of belt-
ing were required for the
longest belt-conveyor system in
the world, linking a gravel de-
posit with the Shasta Dam site



Shasta Dam, the highest concrete overflow dam in the world, will impound the water supply for the \$170,000,000 project. Five hundred and sixty feet high, and 580 feet thick at the base, this immense barrier will measure just under three quarters of a mile along its crest. It will be higher than Grand Coulee Dam and will exceed Boulder Dam in mass.

In preparation for pouring the billions of cubic yards of concrete which will go into this structure, contractors are now erecting the largest conveyor system ever built. Stretching across hills and valleys for nearly ten miles, crossing over the Sacramento River twice, passing over the main line of the Southern Pacific Railway, over U.S. Highway 99, and over five county roads and four creeks, the moving belts will transport 10,000,000 tons of sand and gravel to the site of the dam. Twenty-six 200-horsepower electric motors, each operating one section of the conveyor belt, will keep a steady stream of sand and gravel moving at a speed of 550 feet a minute to deliver as

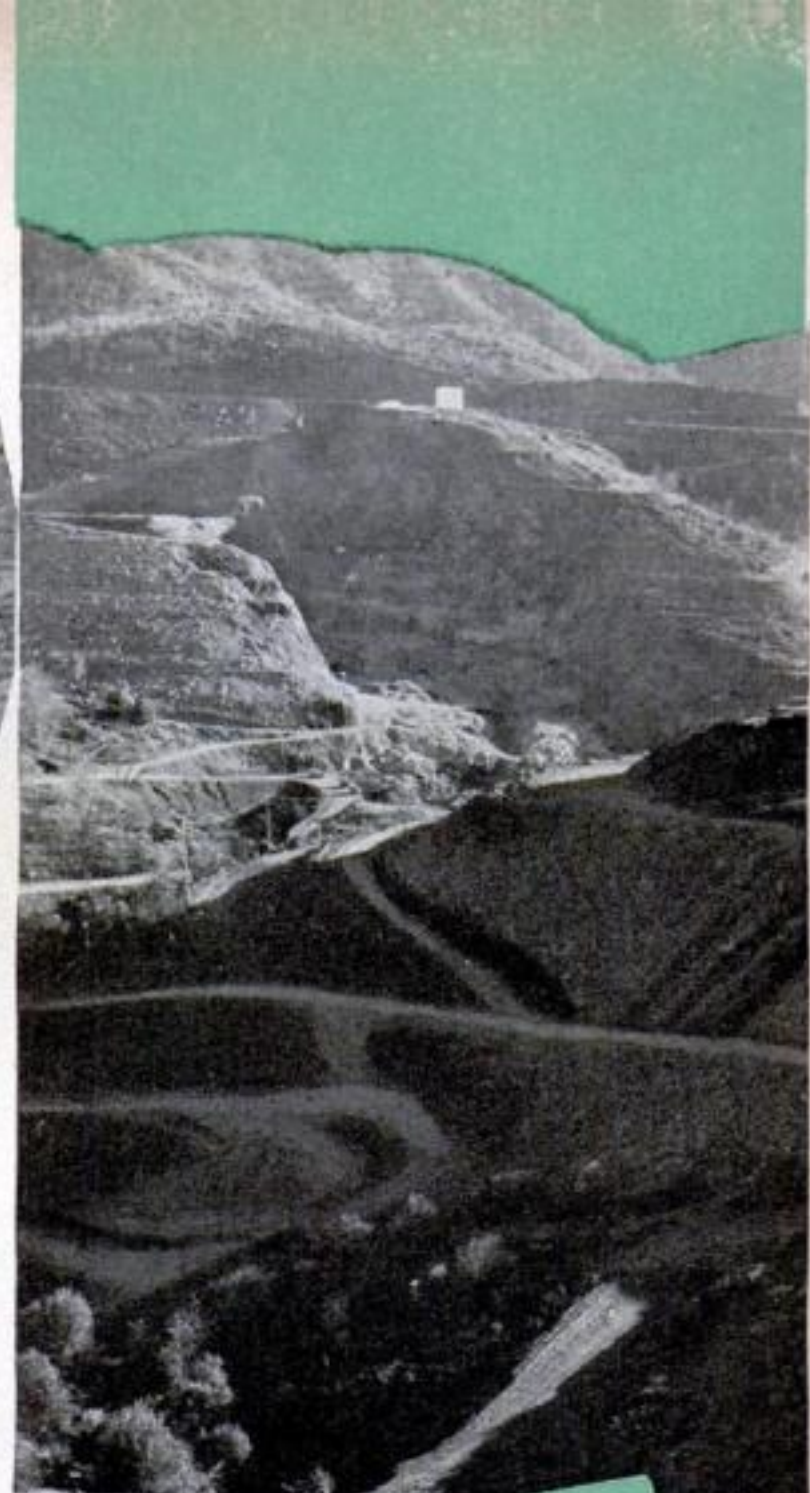




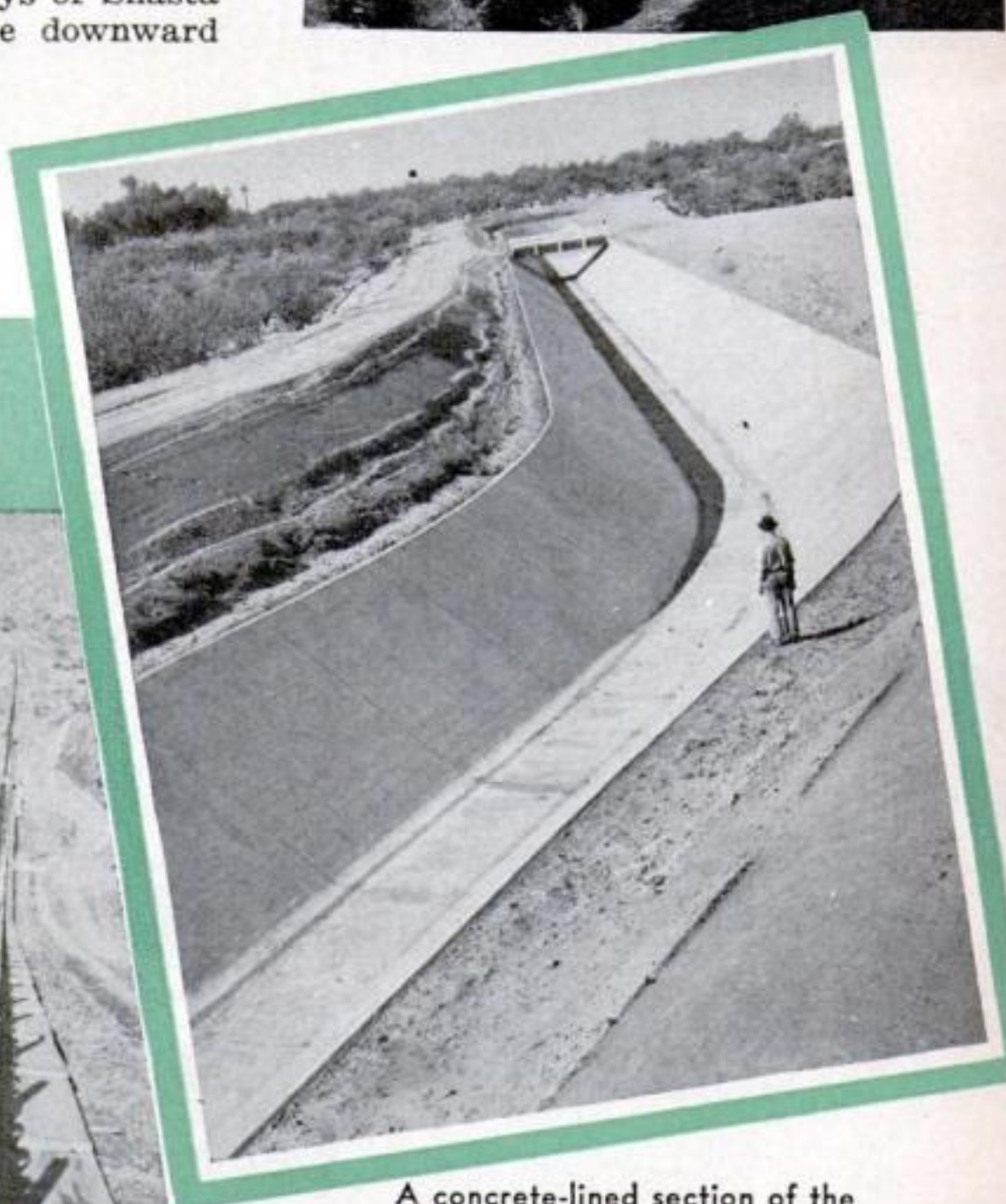
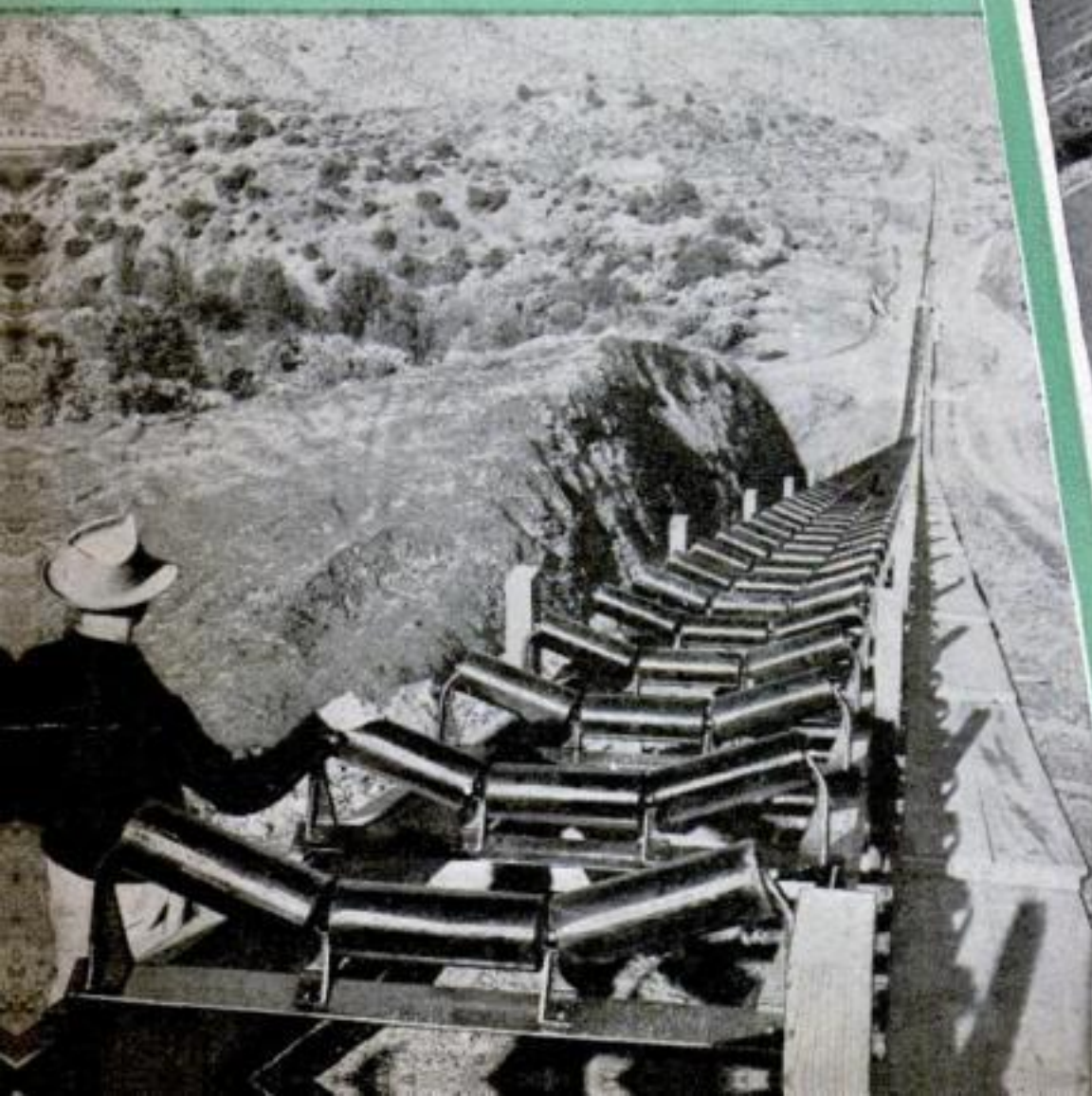
Dynamite "breaks ground" to start construction on the Friant Dam

much as 22,000 tons of material a day at the site of the dam.

Water, rushing out of the high spillways of Shasta Dam, when it is completed, will plunge downward three times as far as the waters of Niagara Falls. The great dam will back up the Sacramento, Pit, and McCloud rivers for a distance of thirty-five miles. By regulating the flow of

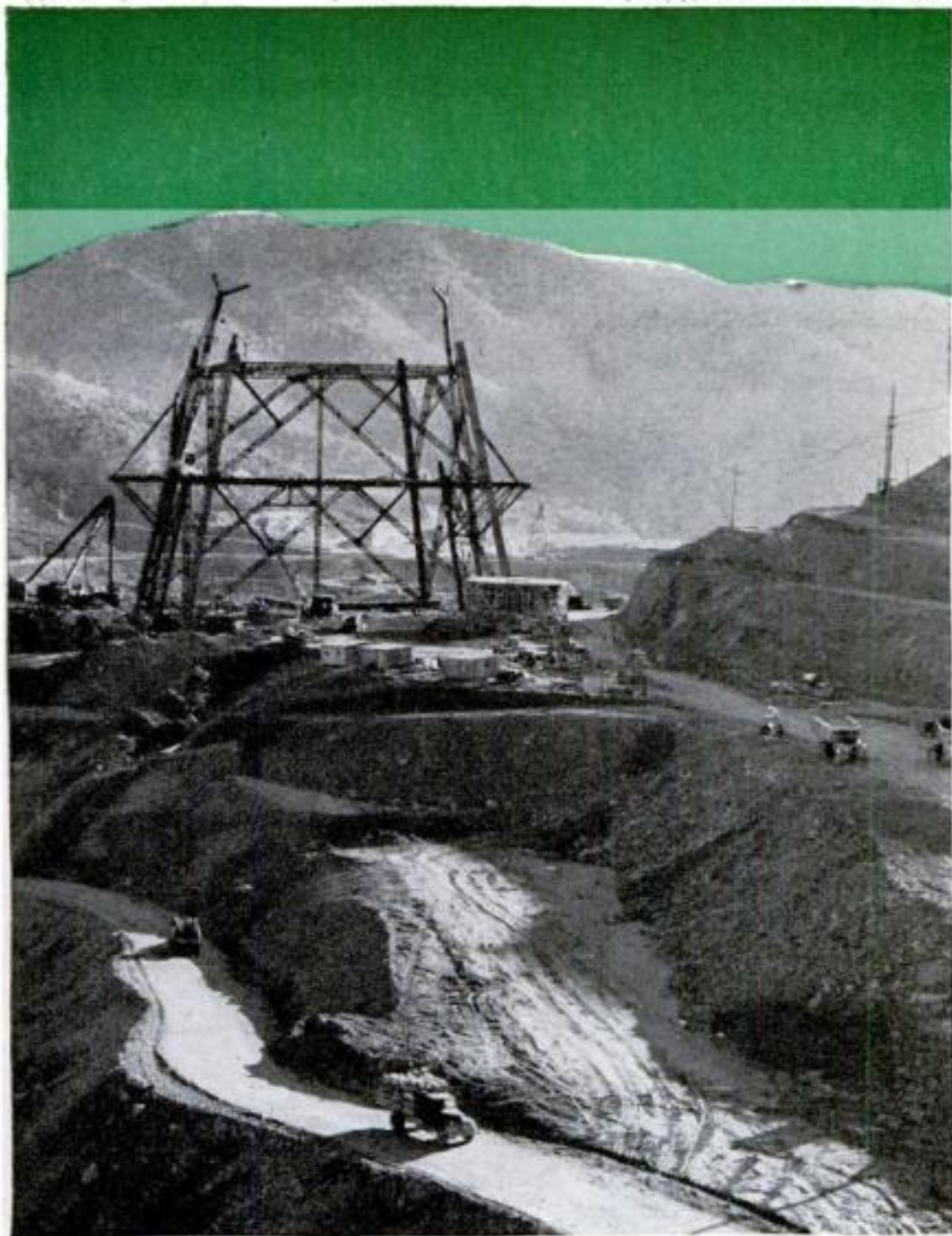


Rollers in place on the ten-mile belt-conveyor system being built to carry sand and gravel for the building of huge Shasta Dam



A concrete-lined section of the vast canal system that will redistribute water for irrigation

POPULAR SCIENCE

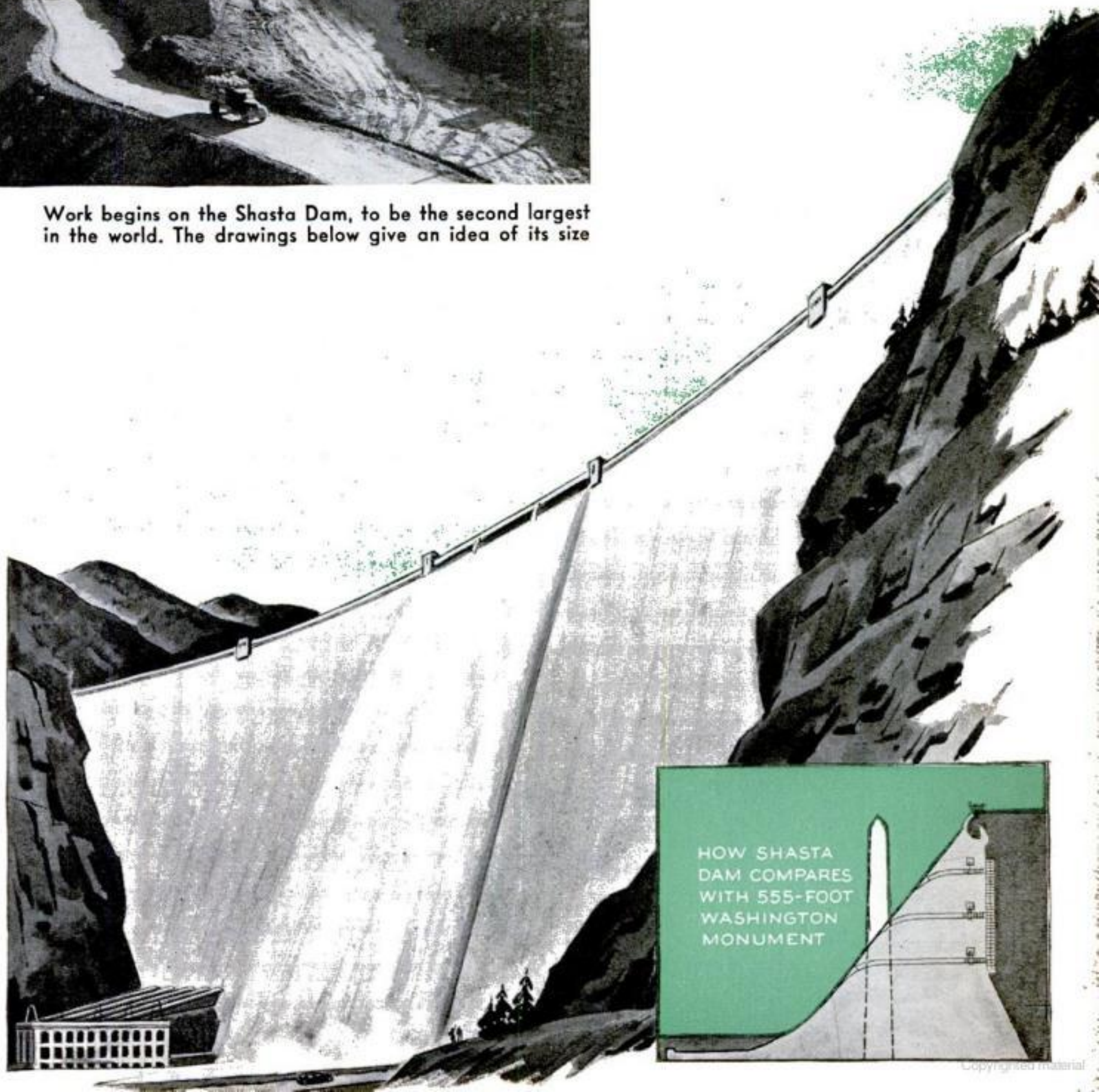


Work begins on the Shasta Dam, to be the second largest in the world. The drawings below give an idea of its size

water, it will make the Sacramento navigable for 160 miles.

Between the two dams, Shasta in the north and Friant to the south, 350 miles of canals, almost countless bridges, numerous aqueducts, tunnels, siphons, and pumping plants will play their part in the complicated operation of the great irrigation system.

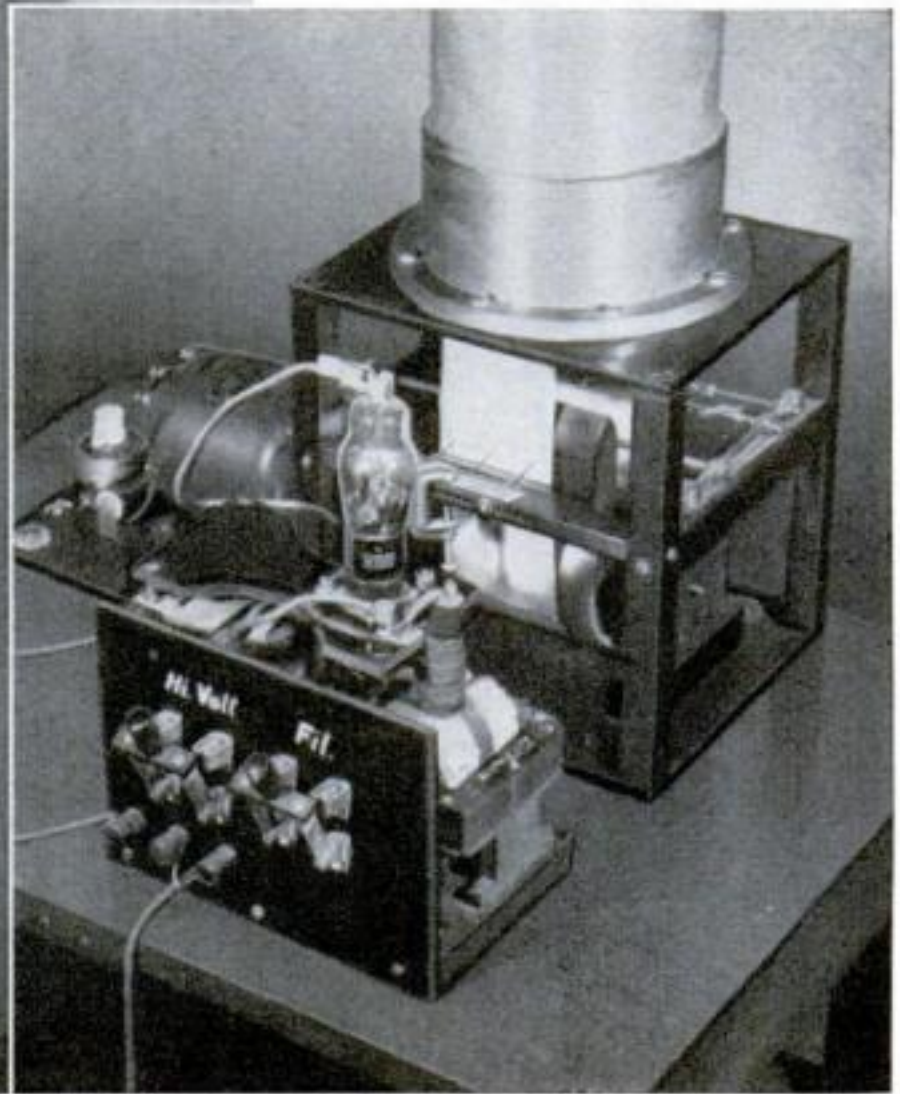
Two thirds of all the rainfall in California's Central Valley descends on the northern end. As a result, more than 50,000 acres of the state's best farm land has been abandoned in the past two decades after the wells went dry. By revamping the natural drainage system of the region, the present vast undertaking will reduce flood hazards in the north and bring water, the lifeblood of the valley, to the farm lands in the south.



HOW SHASTA
DAM COMPARES
WITH 555-FOOT
WASHINGTON
MONUMENT



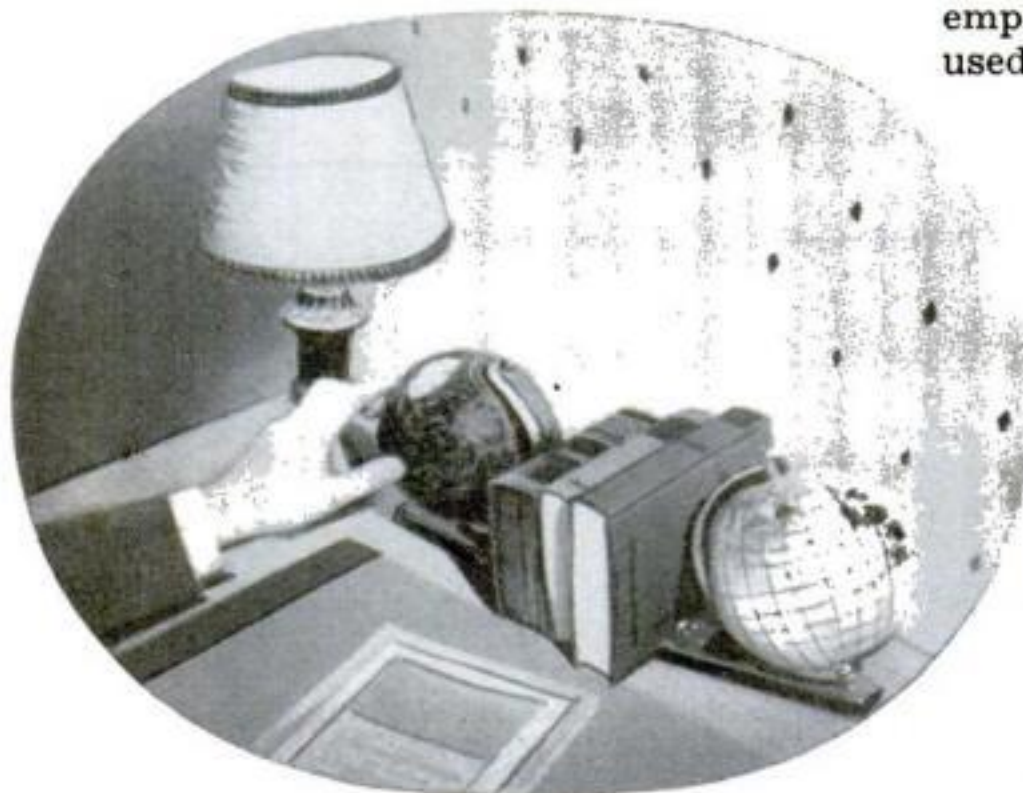
Made largely of spare parts, the atom smasher at left and below helps teach Columbia University students electrical theories. Actually, it is a diminutive model of several huge laboratory prototypes



Atom Smasher Made from Spare Parts

SPARE parts collected from the physics laboratory and skillfully assembled make up the midget atom smasher illustrated above that helps teach Columbia University students the effects of static electricity. Built from commonplace materials, which

include a rapidly moving belt of adding-machine paper onto which is sprayed a direct current of 750 volts, the thunderbolt apparatus is capable of producing charges of more than 300,000 volts and of hurling bolts of lightning a foot long between the spherical poles seen at the top. The device employs the principles of several machines used for advanced electrical research.



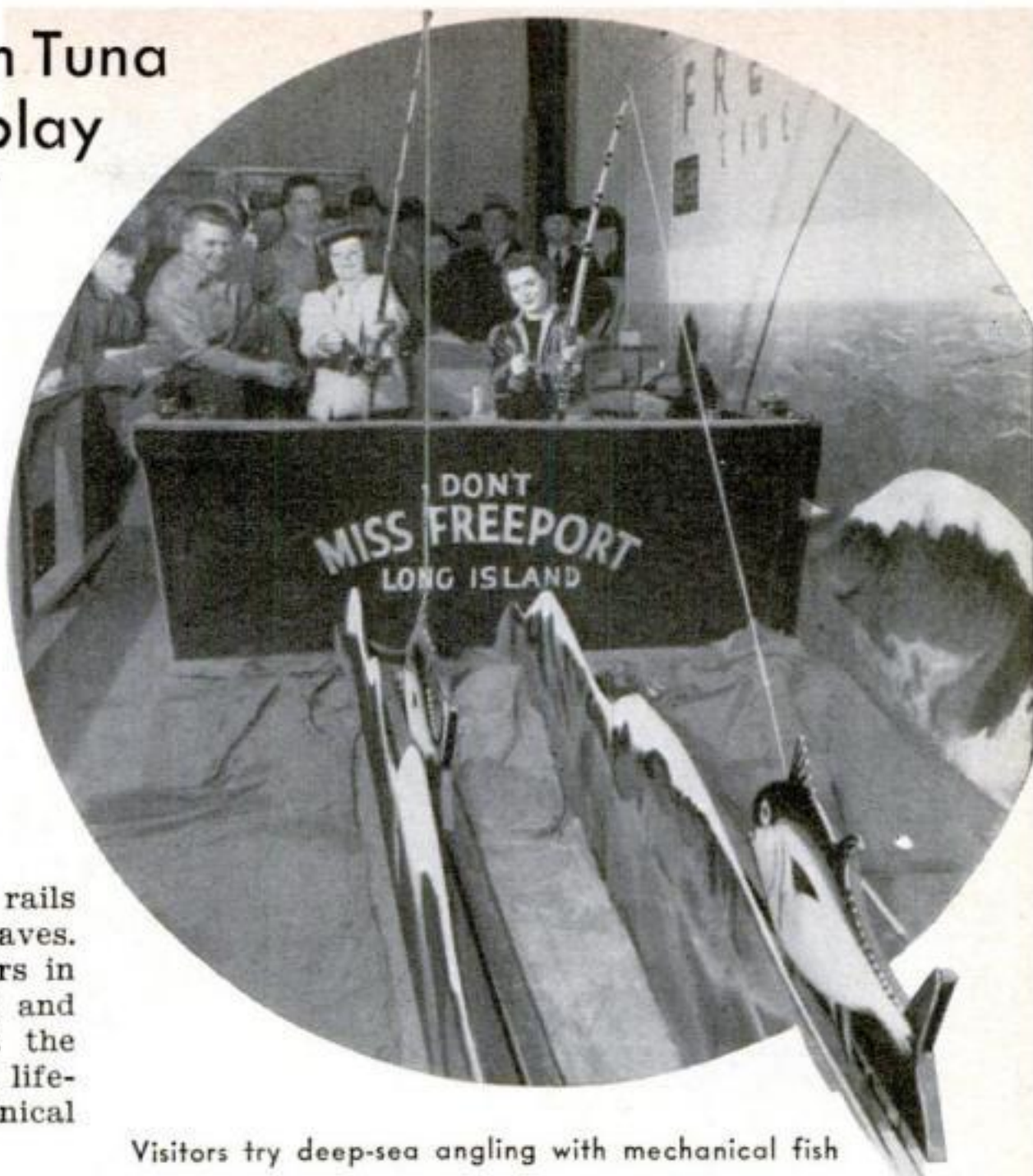
Twin Book-End Globes Show Earth, Night Sky

TWIN revolving globes, one showing the land and water areas of the earth, the other the main heavenly bodies of the sky, have been adapted to form book ends for use on desks or library tables. Supported by a new plastic material resembling glass and tinted a pale blue, the globes are attractively colored. The celestial globe is dark-blue with bright-yellow stars and planets. The novel book ends are expected to prove of special value to students for reference use.

The revolving-globe book ends show the earth and heavens

Anglers Land Tin Tuna in Sports Display

THRILLS of deep-sea tuna fishing were tasted by visitors at a recent sportsmen's show held in New York City. Here, indoor anglers tugged at mechanical fish from aboard an artificial motor boat. The display was arranged by a sportsmen's association of Freeport, L. I., which is the point of departure for a fleet of deep-sea craft that take anglers offshore to indulge in big-game fishing. Real tuna tackle was used at the display and visitors pulled the mechanical fish in toward the boat along rails hidden by imitation ocean waves. Experts coached the anglers in the correct use of the rod and reel. The ocean scene at the back of the booth and the life-like coloring of the mechanical fish added to the realism.



Visitors try deep-sea angling with mechanical fish

Hobbyist Wears Thirty Watches

CHAMPION watch-watcher of the world is Charles Brown, an English hobbyist who starts out in the morning with as many as thirty timepieces ticking on his person. In addition to conventional pocket and wrist watches, he wears tiny timepieces in the form of cuff links, rings, and lapel buttons. For years, Brown has collected watches.

Acrobatic Panda Is Novel Toy

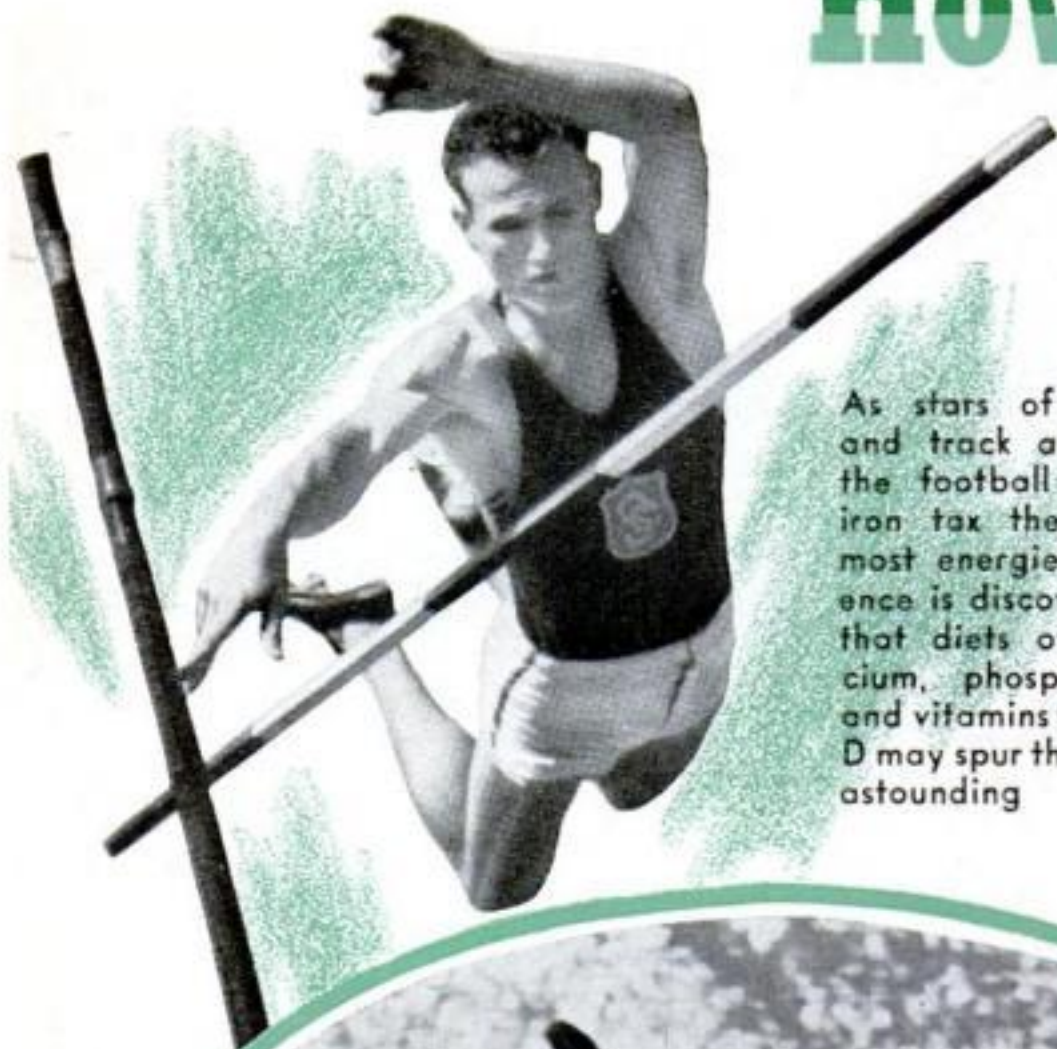
BY-PRODUCT of an engineer's experiments with vibration in machines, a new toy panda can be made to perform somersaults, hand-springs, and other acrobatic stunts by operating a wire leash. Unlike spring toys, which run down, the new plaything performs as long as the child works the wire.



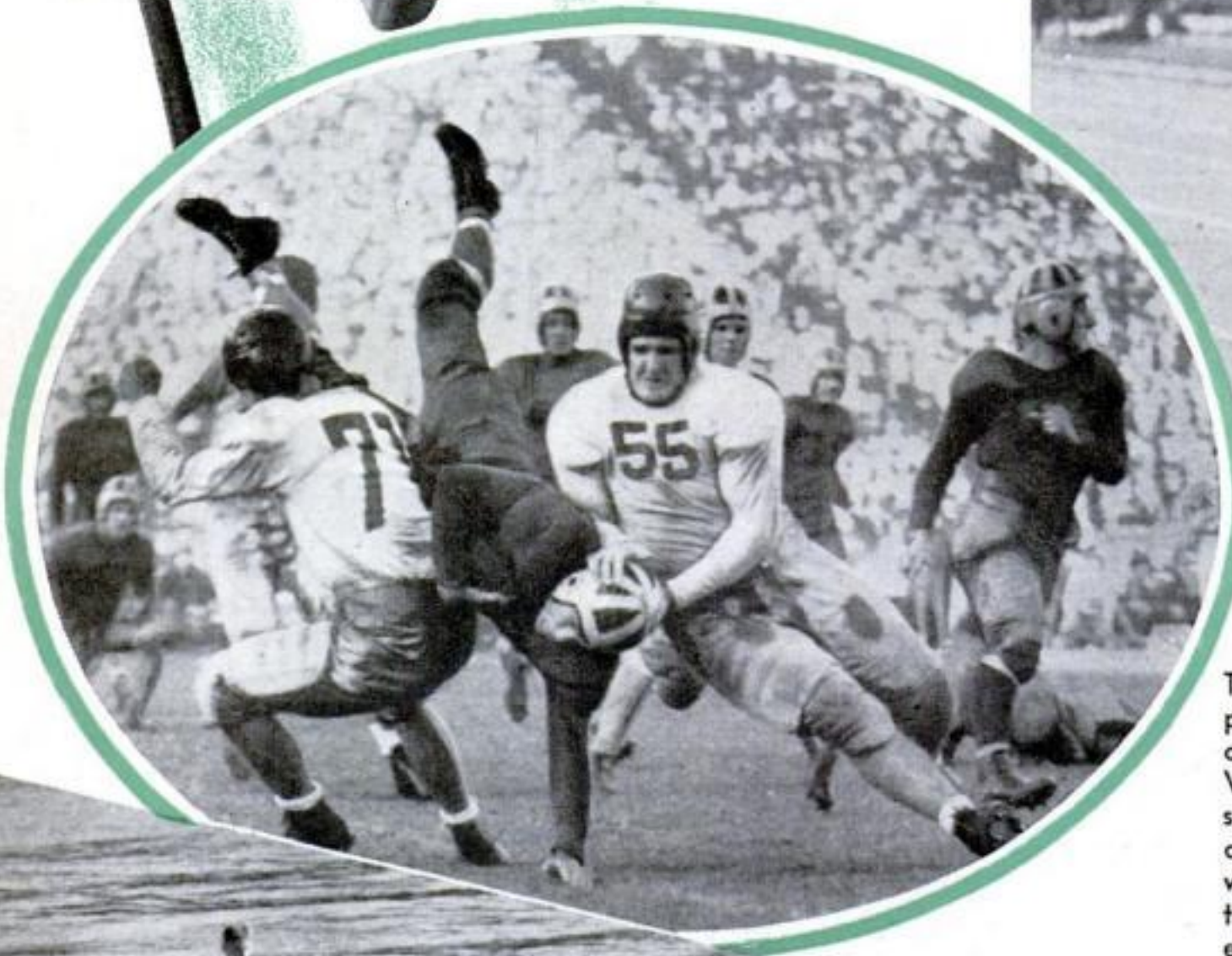
Charles Brown wondering what time it is. Seven watches show; do you see them?



How Chemistry



As stars of field and track and of the football grid-iron tax their utmost energies, science is discovering that diets of calcium, phosphorus, and vitamins C and D may spur them to astounding feats

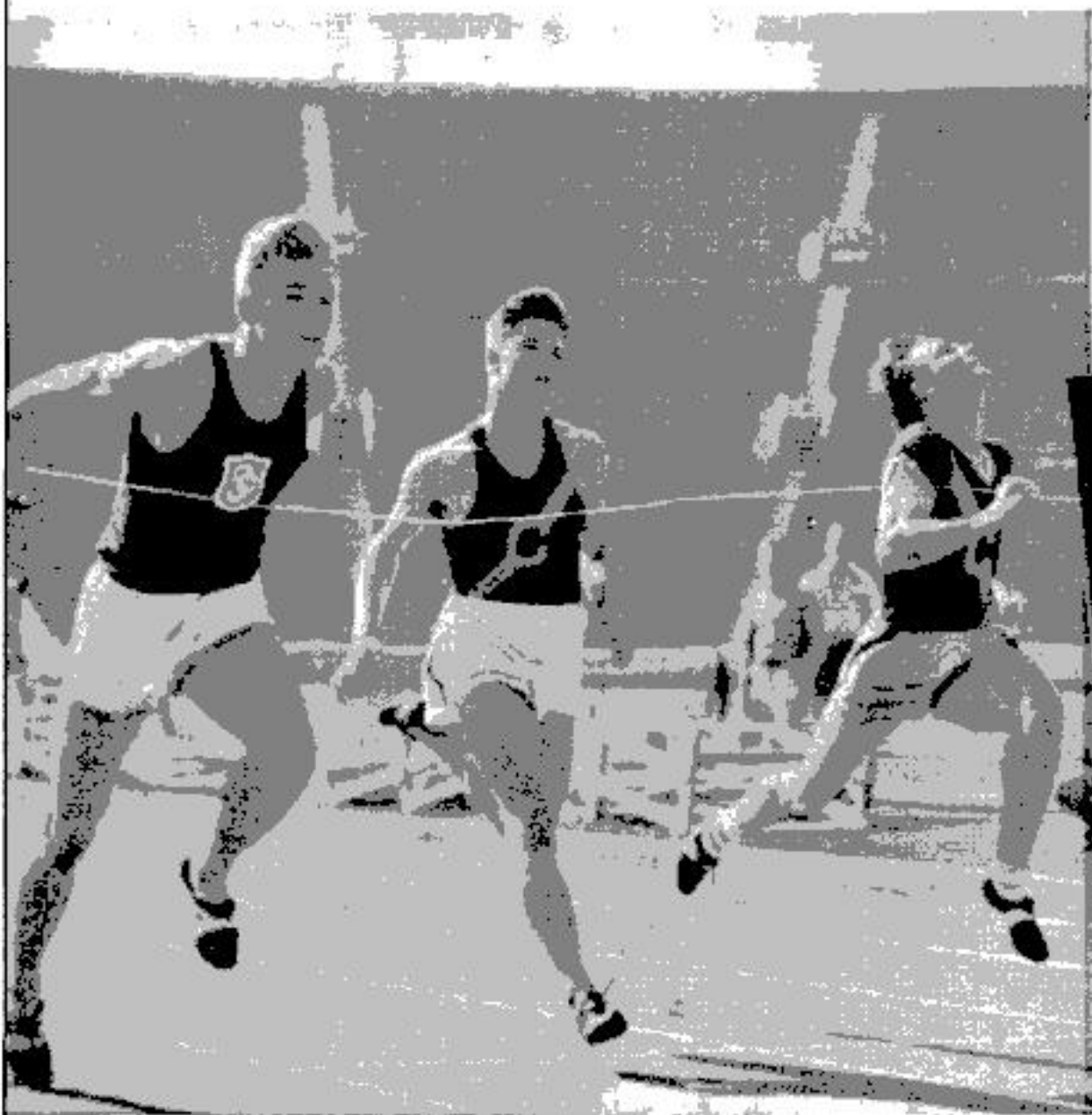


Typical athletic supremacy is shown by college crews on the West Coast where sunshine gives abundant vitamin D and where coaches see to it that their men eat food containing the proper minerals



Makes Better Athletes

By
**R. DE WITT
MILLER**



TWO runners fight out the last bitter yards to the finish line in the final surge of speed. Muscles knot and drive, hearts pound, lungs gasp for the last ounce of precious oxygen.

Then one runner falters, his strength spent. The other maintains the terrific pace, and even increases it. For he has the staying power, the ability to summon one more ounce of drive from his aching muscles.

Everyone has watched just such a performance, watched in one way or another in practically every competitive sport. What is it, that gives to one athlete that all-important staying power that is the mark of a champion, and denies it to another?

As the result of recent dramatic research, science believes that it has at last found the answer to that question. The answer involves vitamins, those alphabetically named constituents of food, and two common chemicals, calcium and phosphorus. And

because of this new knowledge, super-athletes, men to whom modern chemistry has given strength and endurance never before known to human beings, may soon be owing a host of broken sports records to a test tube.

The chain of research began a few years ago when a German scientist noticed that the amount of calcium in a person's body seemed to have a bearing on his ability to carry through sustained muscular activity. As an experiment, he gave fifteen track athletes doses of calcium gluconate, a common, pleasant-tasting substance which dentists often prescribe for children whose tooth decay indicates a calcium deficiency.

After the athletes had received the calcium gluconate for a period of five months, their performances were checked against those of twelve other athletes who had lived under identical conditions, had had the same amount of training, but had not received

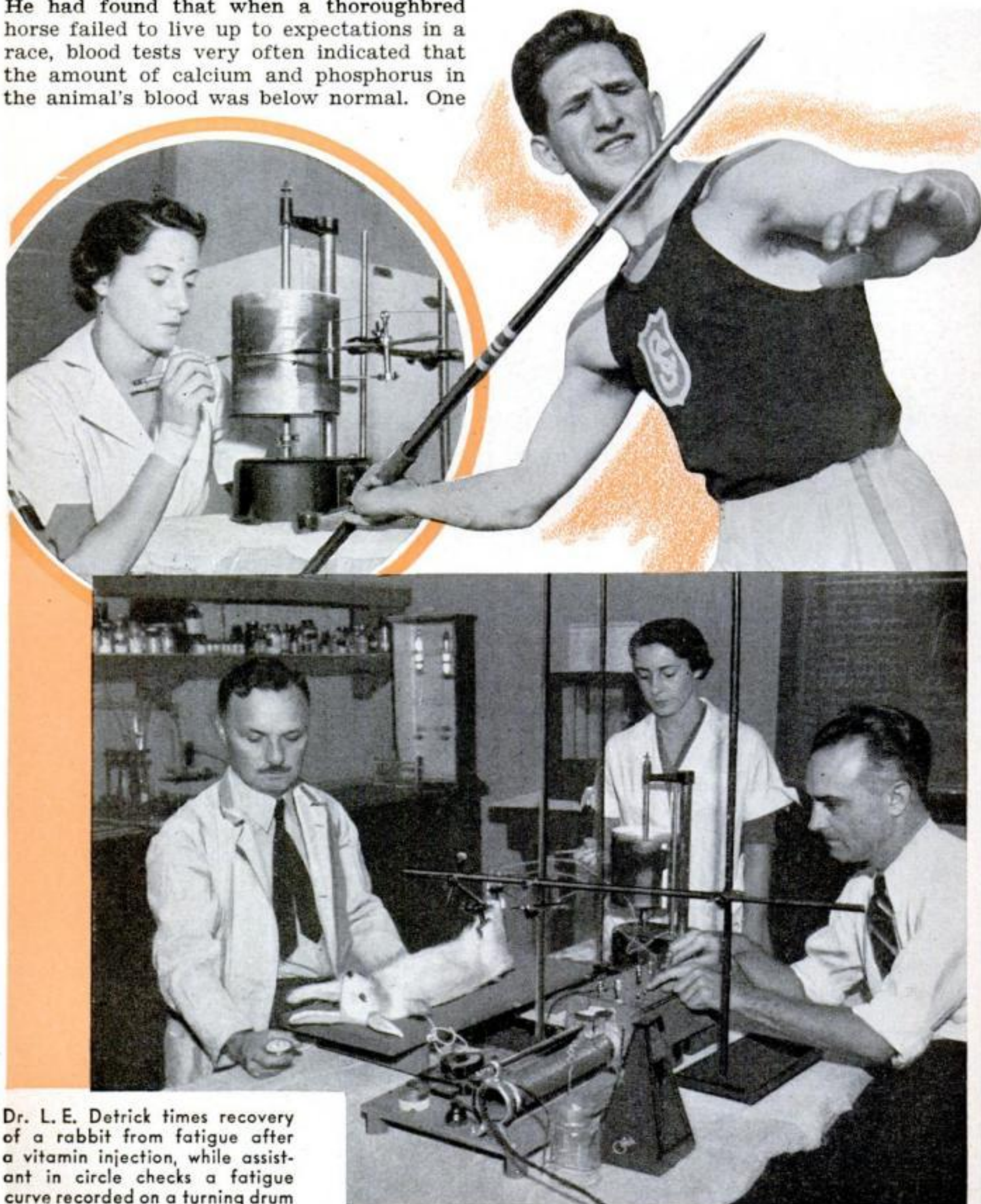
SCIENCE BREWS SPORTS RECORDS IN TEST TUBES

the calcium dosages given to the others. Results were startling. After a 400-meter race, the calcium-treated athletes showed sixty percent less fatigue than those not treated. Moreover, the treated group were found to recover their normal pulse rates much more quickly after a race.

At about the time this German research became known, Dr. Royal C. Perkins, nationally known biochemist of Pasadena, Calif., was working on the same problem. He had found that when a thoroughbred horse failed to live up to expectations in a race, blood tests very often indicated that the amount of calcium and phosphorus in the animal's blood was below normal. One

horse, considered to have little chance in its maiden race, was found by him to have twice the normal amount of calcium and phosphorus in its blood. This animal won its first race by eight lengths—and the owner fainted.

While studying this reaction of thoroughbreds to calcium and phosphorus, it occurred to Dr. Perkins that athletes should exhibit unusual ruggedness in those areas



Dr. L. E. Detrick times recovery of a rabbit from fatigue after a vitamin injection, while assistant in circle checks a fatigue curve recorded on a turning drum



From blood tests of race horses fed on chemically rich pastures, science has learned much of the chemistry of animal speed and endurance, applying the knowledge to make better athletes

where they normally received plenty of calcium, phosphorus, and sunshine. Sunshine is necessary to supply vitamin D, since the human body cannot absorb calcium without its aid.

A survey of athletic records soon indicated that his assumption was correct. In the realm of track and field athletics, for example, he noted that the two greatest aggregations of track athletes came from a region rich in foods containing large amounts of calcium and phosphorus, and where sunshine is plentiful. These teams, the University of Southern California and Stanford University, both from the sunny Pacific Coast area, have displayed ruggedness and staying power in superlative amounts.

And in the field of crew racing, a sport requiring tremendous stamina, he noted that the two most formidable crews have been those representing the universities of Washington and of California.

In cold northern countries such as Finland, Sweden, and Norway, famed for their rugged athletes, Dr. Perkins points out that the customary food is rich in calcium and phosphorus, while vitamin D is supplied by the oils found in fish.

Vitamin D, however, is not the only vitamin factor that has a bearing on the problem, for another California scientist, Dr. Lawrence E. Detrick, of the University of California at Los Angeles, has performed significant laboratory experiments on albino rabbits that have proved the power of



vitamin C in relieving muscular fatigue.

To anesthetized rabbits, the experimenter attached threads that joined certain muscles of each right back leg to an inked pen. Electrodes sent weak electrical impulses sweeping through the muscles at regular intervals. With each impulse, the muscles contracted, pulling the threads and causing the pens to trace their movements on turning paper-covered drums. As muscle fatigue progressed, the lines made by the pens gradually become shorter.

Then Dr. Detrick injected a tiny amount of ascorbic acid, or synthesized vitamin C, into the animals' blood streams. After a minute or so, muscular energy returned, and the legs began to kick with vigor.

With this recent surge of progress in the field, it may not be too far-fetched to look forward to the day when the test tube and the microscope will be spurring athletes on to the greatest achievements of all time.

Being Nosey Is Their Job

ALTHOUGH the beaks of Pinocchio the puppet and Jimmy Durante the actor are probably better known, the noses of four men who work in the subways of New York City are also worthy of fame, since they safeguard the lives of millions of riders. Hired by a gas company, the men go from one subway station to another sniffing the air for leaking gas.



One subway inspector uses this way to sniff any gas clinging to his coat. Right, testing nose sensitivity



Desk-type elastic dispenser in use, and how it works

Finger-Tip Dispenser for Rubber Bands

RUBBER BANDS can now be neatly dispensed with a device just made available for office and home use. Made of attractive plastic material, the dispenser contains a cuplike holder for the elastics, at the bottom of which is a spring to force the bands against a slot at the top. Even when the supply is almost exhausted, the bands are always kept pressed against the top opening where one can easily be pulled free.



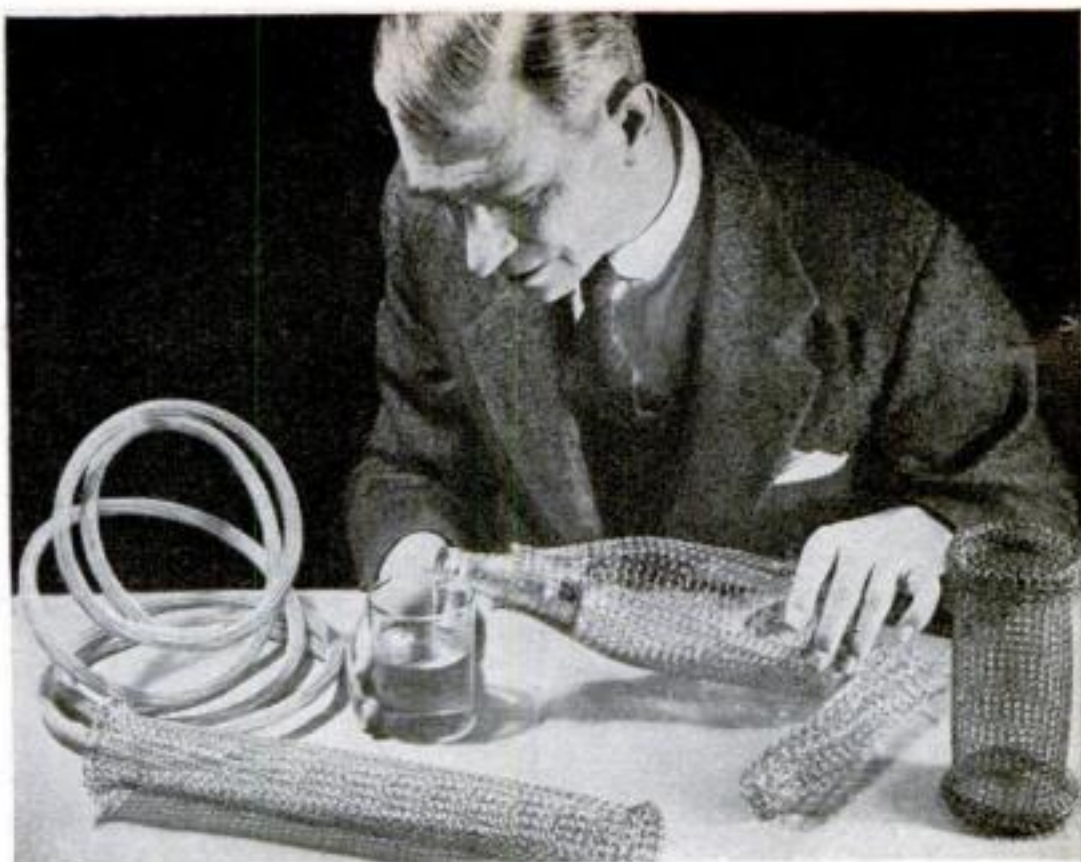
Self-Opening Envelope

OPENING a letter is a simple operation, when the novel envelope below is employed. One corner of the specially folded letter sticks out through a clipped-off corner of the envelope. To open the letter, it is necessary only to pull this exposed corner, the letter ripping the envelope open.



Flexible Tubing Is Knitted from Wire

FLEXIBLE tubing knitted from wire in decorative mesh patterns is a novel product. Manufactured by a process invented by Frank C. Stephens, of Washington, D. C., the tubing is being used in making dog leashes, protective coverings for bottles and test tubes, candlesticks, boudoir lamps, mannequins and dolls, and armor for rubber hose. It is manufactured in diameter sizes from three eighths of an inch to two inches, and may be as rigid or as pliable as required by the specific use for which it is intended.



Knitted from wire, this flexible tubing has many applications

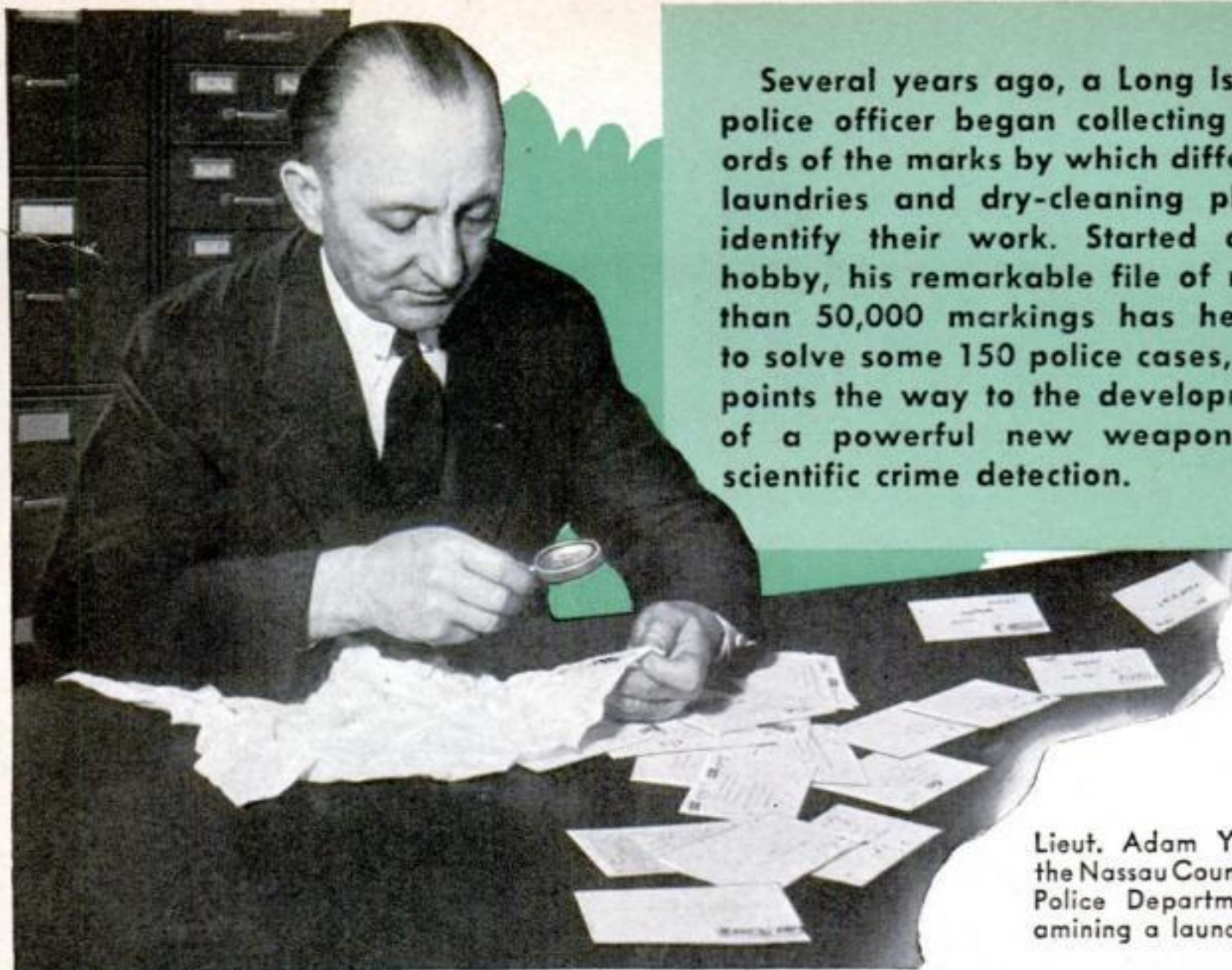
Wood Carver Uses Himself as His Model

FASHIONING wooden caricatures of himself is the novel occupation of William Zegel, of New York City, whose vocation grew from a boyhood interest in wood carving. Zegel, who sells his figures for advertising and display work, serves as his own model for the little figures, as is easily seen in the photograph below. The hats on the miniature chefs are made of cloth, but the rest of the costume is fashioned from a plastic compound that is sprayed on the wooden carving, smoothed over, and painted.



William Zegel finishing up one of his window displays. Note that the carved heads at right are all caricatures of the artist





Several years ago, a Long Island police officer began collecting records of the marks by which different laundries and dry-cleaning plants identify their work. Started as a hobby, his remarkable file of more than 50,000 markings has helped to solve some 150 police cases, and points the way to the development of a powerful new weapon for scientific crime detection.

Lieut. Adam Yulch, of the Nassau County, N.Y., Police Department, examining a laundry mark

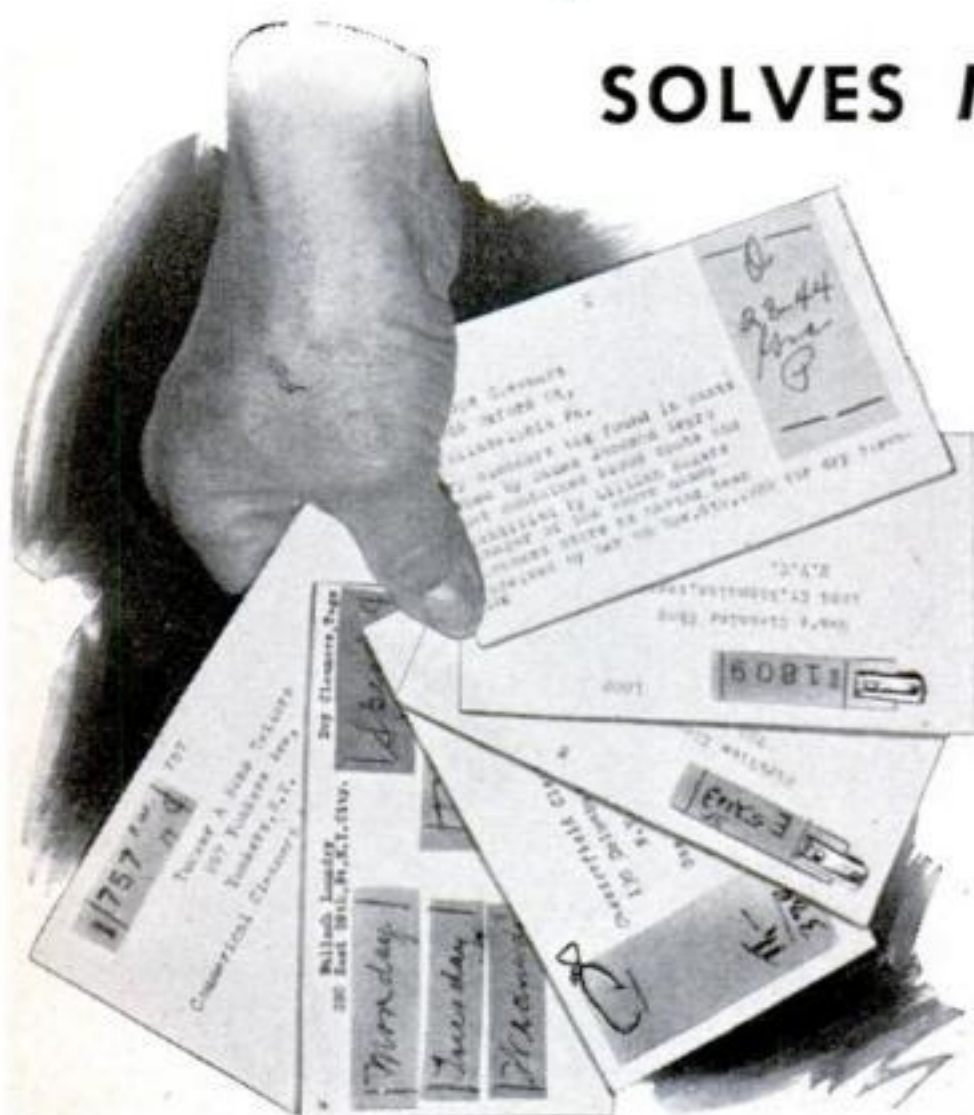
Laundry-Mark Detective

SOLVES MYSTERIOUS CRIMES

By EDWIN TEALE

IT WAS three o'clock on a recent afternoon. A dock worker at Long Beach, N. Y., glanced beyond the piling he was examining and suddenly raced for the nearest telephone. Police cars rushed to the spot. Detectives started combing the area for clues. For, the sight which had sent the worker hurrying to call Headquarters was the bound and gagged body of a murdered man, lying face downward in the sand. Ten times his skull had been fractured by brutal blows.

The victim was identified as Samuel Rappaport, sixty-eight-year-old jewelry salesman of Long Beach. His overcoat, his black jewelry bag, his monthly railroad ticket, were later discovered hidden at various points along the shore. Most valuable find of all, however, was a bundle of bloodstained towels, tied together with a sash cord and secreted in dense weeds. Within half an hour after



Cards like these, in the Long Island detective's file, record the markings used by laundries and dry-cleaners

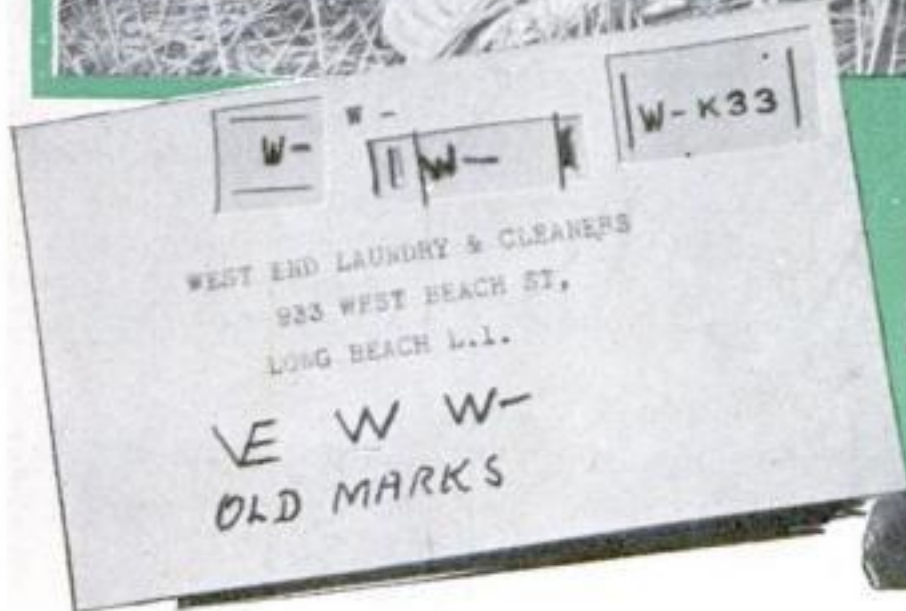
they were picked up, the towels were passing under ultra-violet lamps at the Mineola, L. I., headquarters of the Nassau County Police.

Inked in the corner of each was the symbol: "W-K 33." To any detective, that would have been a worth-while clew. But at Mineola it was more than that. It was virtually the address of the killer. For, here, the nationally known laundry-mark expert, Lieut. Adam Yulch, maintains the most elaborate file of laundry and dry-cleaning marks in existence. Swiftly Yulch dipped into his file of tens of thousands of carefully catalogued cards. The symbol: "W-", was used by the West End Laundry, in Long Beach. The manager of that establishment, in a few minutes, found the address of the customer, "K 33." And, less than twenty-four hours after the towels were picked up, the police had arrested a suspect and were announcing the confession of the murderer.

It was a sensational daylight holdup, some years ago, that started the Long Island detective perfecting this new tool for scientific crime detection. At Farmingdale, L. I., thugs with drawn revolvers pounced on a bank messenger and roared away with a \$20,000 haul. Later, their abandoned car was discovered in another town. It contained a brown coat with a dry-cleaner's mark in one sleeve. Lieut. Yulch was assigned the job of finding the shop where the mark was made. Day after day, week after week, he went from one dry-cleaner to another. Two months went by and he had visited 200 shops before he came to the right one. But the tip he received there resulted, eventually, in the arrest of the thugs.

During that long search, Yulch realized how valuable a collection of dry-cleaning and laundry marks would be. He began collecting such symbols in his spare time. Nights, he filed them on standard three-by-five-inch cards. By 1938, he had 5,000 symbols catalogued. His unusual hobby began to attract attention. His superiors, Commissioner Abram W. Skidmore and Inspector Harold R.

Near the scene of a sensational murder, Yulch finds a bundle of blood-stained towels. A laundry mark, seen in the circle below, is identified by means of the file card reproduced



Yulch examining a shirt with ultraviolet light for markings in invisible ink. The scrap of cloth at the right solved a "torch-murder" case



King, turned him loose to devote all his time to building up a laundry-mark bureau.

Today, steel drawers at the Mineola headquarters hold between 50,000 and 75,000 marks. An actual tag is clipped to each card and the name of the laundry or dry-cleaning shop is typed below. Some establishments use numbers, others letters, others symbols—such as dollar signs, hourglass markings, or horseshoes—to identify their work. All of Yulch's cards are catalogued according to number, symbol, or letter. When the mark is changed, as it was three times in the case of the West End Laundry, the shift is noted on the card.

Soon after his hobby had turned into a life work, it received spectacular vindication. One of the smoothest, most elusive burglars ever encountered on Long Island began preying on the homes of wealthy residents. He specialized in furs and silverware. He never left a fingerprint and after every burglary he seemed to vanish into thin air. The newspapers were full of the crimes of "The Phantom Burglar." His loot totaled more than \$100,000 and his successful robberies numbered nearly 100 when two detectives cornered him as he was leaving a Jamaica, L. I., apartment. A huge, silent-footed man, he appeared to have black paws instead of hands. To prevent fingerprints, he

had slipped silk socks over his hands before starting out on his night's work.

At headquarters, the prisoner refused to utter a sound. Fingerprints revealed he was Morris Kotler, a veteran housebreaker with a string of convictions behind him. But, twenty-four hours of high-pressure questioning left the whereabouts of his loot a mystery.

At this point, Yulch and his file came into the spotlight. A single laundry mark on the collar of Kotler's shirt enabled the detective to trace it to a Lynbrook, L. I., laundry and from there to the room where a fortune in stolen silver and furs was cached.

SO FAR, Yulch and his unique file have solved more than 150 cases. His collection of telltale markings have aided the Federal Bureau of Investigation and the U. S. Treasury Department, as well as law-enforcement officials of a dozen states. Summers, Yulch often spends his vacation in a busman's holiday, canvassing the towns he visits for additional laundry marks. He never knows when they will be helpful. Last August, for instance, he found himself near Binghamton, N. Y., and collected samples of all laundry and dry-cleaning marks there. A few months later, Treasury agents swooped down on a large whisky still near the city and confiscated clothing left by the escaped moonshiners. Through Yulch's file, they were able to trace the clothes to the men who owned them.

Occasionally, more than one laundry or dry-cleaning plant will employ the same number or symbol as its identification mark. Even so, the file at Mineola narrows down the search to a few shops and saves precious

time. This was the situation last year in the sensational "Palisades Torch Case" which Yulch's file brought to a surprising solution.

Just beyond the New Jersey end of the George Washington Bridge over the Hudson River, police found the charred body of a man wired to a tree. Near-by was an empty gasoline can and a partially empty box of matches. Leaves, twenty feet in the air, had been seared by flames. The dead man, literally burned at the stake, appeared to have been the victim of a fiendish murder plot.

Miraculously, a (Continued on page 224)



In the laundry-mark detective's cabinet, above, police picked up the trail leading to the solution of a gem salesman's death



First the trail led to the house in oval, said to be the scene of the crime. Above, prisoner shows detectives where, according to his confession, he threw the victim's body into the water

Modern Betsey Ross Restores Old Flags



Mrs. Thomas B. Richey with the flag of a Civil War artillery regiment, which she has restored. At the right, she is seen at her unusual work

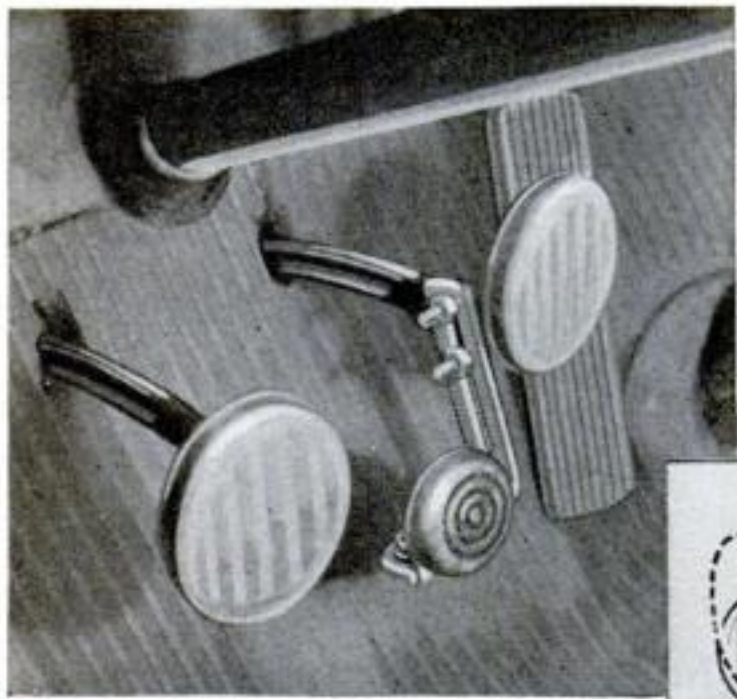
RESTORING tattered banners, priceless in their association with American history, is the unusual work of Mrs. Thomas B. Richey, wife of a captain in the U. S. Navy. At the Brooklyn, N. Y., Navy Yard, she has repaired more than 3,000 historic flags. Linen thread is used because of its lasting quality and all new material is dyed to match the mellow shades of age. The work is done on a non-profit contract basis. Her first job was restoring the famous "Don't Give Up The Ship" flag used by Oliver Hazard Perry at Lake Erie; her latest, repairing 800 flags from West Point.



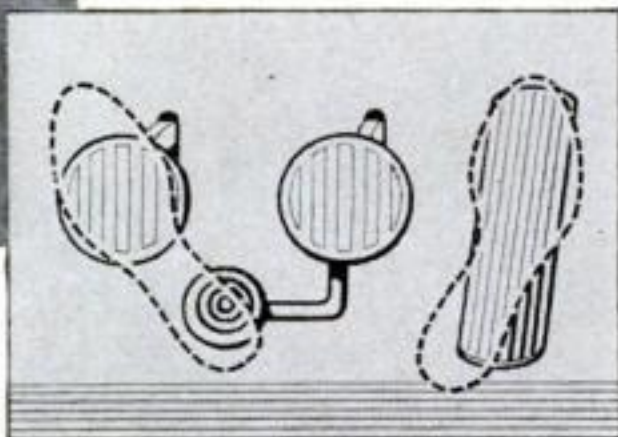
Pedal Attachment for Cars Aids in Starting on Hill

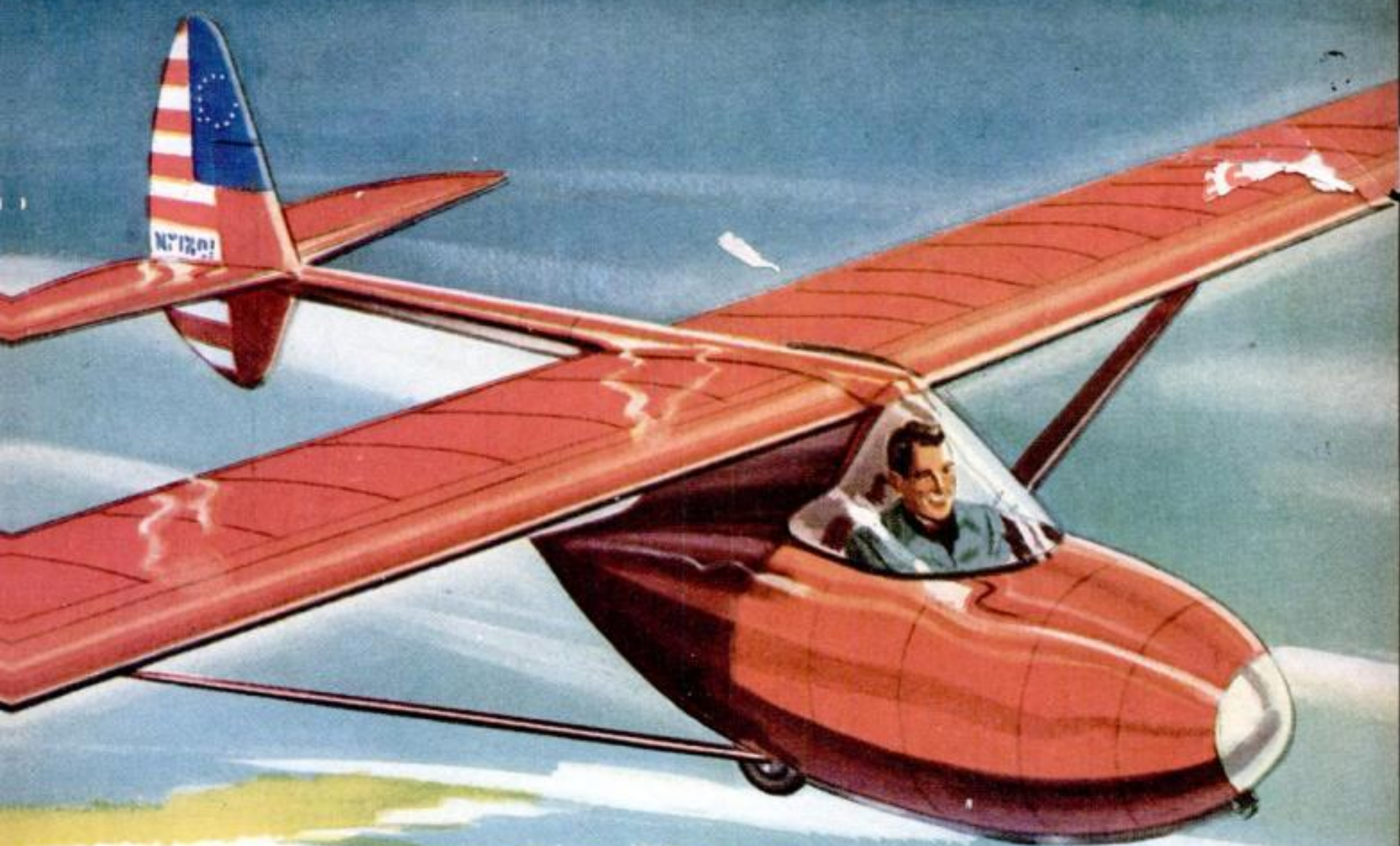
TO SIMPLIFY the work of keeping an automobile from rolling backward while the motorist is starting on a steep hill, a Pennsylvania manufacturer has placed a simple attachment on the market. A compact extension pedal, it is clamped by means of two bolts to the brake pedal. By swinging the heel of

his left foot slightly to the right, the motorist can push down both brake and clutch pedals with the one foot, leaving the other free to operate the accelerator. The accessory is adjustable to fit feet of different sizes, and can be installed in two minutes.



"Hill holder" attached to car's regular brake pedal. It enables the left foot to operate both clutch and brake, as at right





New Boom in GLIDERS

Thrilling Aerial Sport
Gains Wider Popularity
Through Knockdown Kits
That Enable Anybody To
Build His Own Sailplane,
Buying All the Materials
on a Pay-as-You-Go Plan

By ANDREW R. BOONE



HOW GLIDER FANS

Rudder framework of a mail-order knockdown glider, assembled with nails and glue, before covering

Below, attaching wings to the fuselage. The builder buys parts and pays for them separately as he goes along



Interest in gliding is shown by this crowd examining an entry at a California meet

ASSEMBLE AND FLY MOTORLESS PLANES

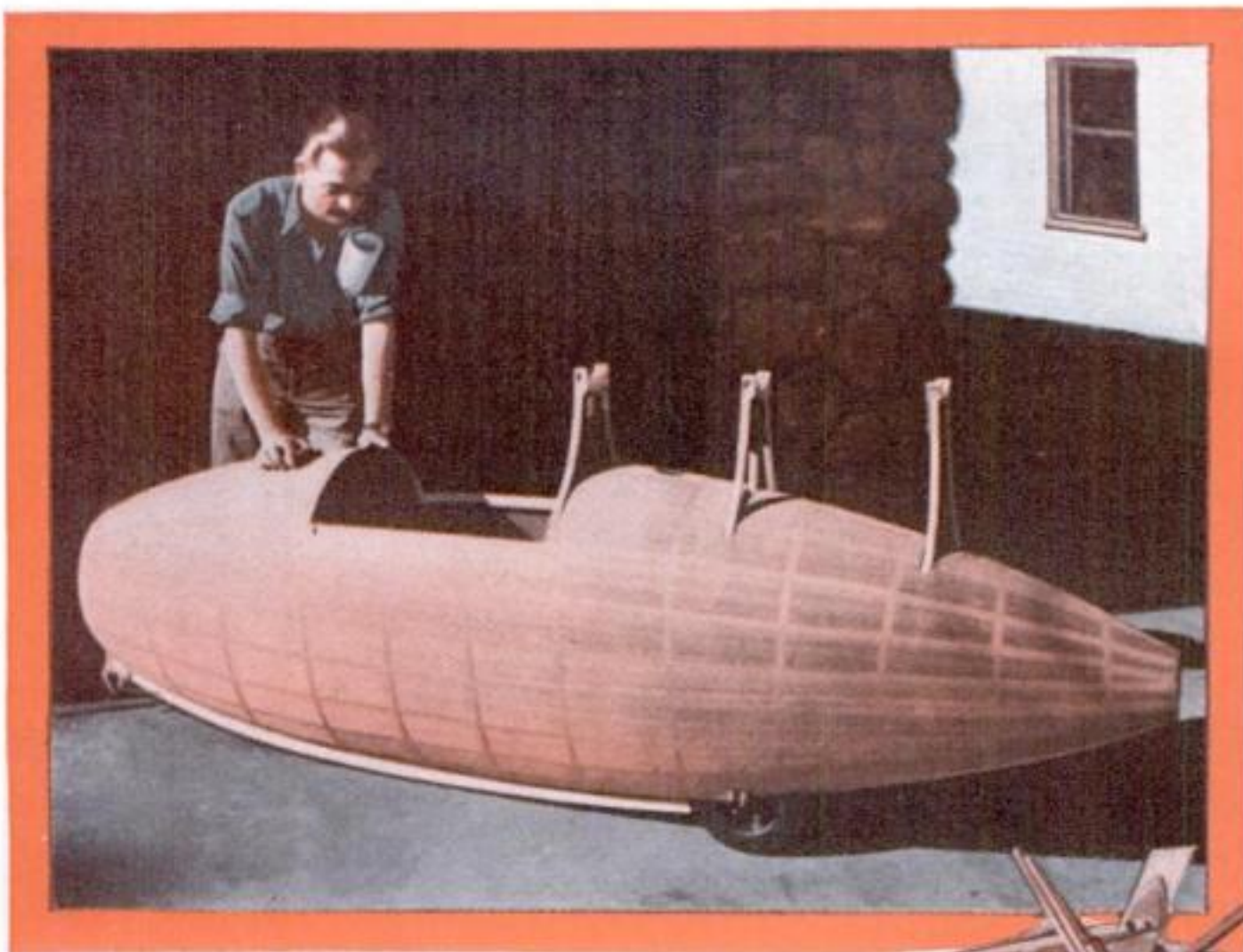
SOARING on wings assembled in back yards and home workshops, hundreds of glider enthusiasts are piloting their own sailplanes. Bought on the installment plan, their ships come in knockdown kits. Piecemeal buying enables boys and men alike to build gliders. As a result, flying without power is sweeping the nation. More than forty meets will be staged this year, from the big national events like the one held annually at Elmira, N. Y., to small sectional competitions on farm lots, desert lakes, and mountain pastures. Two hundred clubs have been formed with 2,000 members.

Aside from the kits, would-be soarers need purchase few accessories. Tow rope, a couple of wrenches, air-speed meter, and a sensitive variometer fill the bill. In many towns groups club together, building their own soaring planes and coöperating in fly-

ing. At a cost far less than that of a powered plane, their members enjoy the thrills and pleasures of flying. Danger of injury is less, too, for they can land the light craft at comparatively slow speeds.

Several types of knockdown gliders have been evolved, from heavier primary trainers to streamline planes capable of soaring to great heights and flying long distances. In one novel ship, designed by Hawley Bowlus, pioneer American glider pilot and builder, the pilot sits in a podlike nacelle suspended from the wings, which are attached to the tail by a duralumin boom six inches in diameter. Sailplanes of this type, which weigh only 250 pounds, glide best at a speed of forty-two miles an hour and land at twenty-seven, but may be dived 100 miles an hour and put through aërobatics.

For \$175 to \$385, which is paid as you



The podlike nacelle must be sanded down smooth before varnish is applied. Below, a kit of parts for the tail assembly is being uncrated. Detailed plans and instructions included with every set make it easy for beginners to assemble gliders

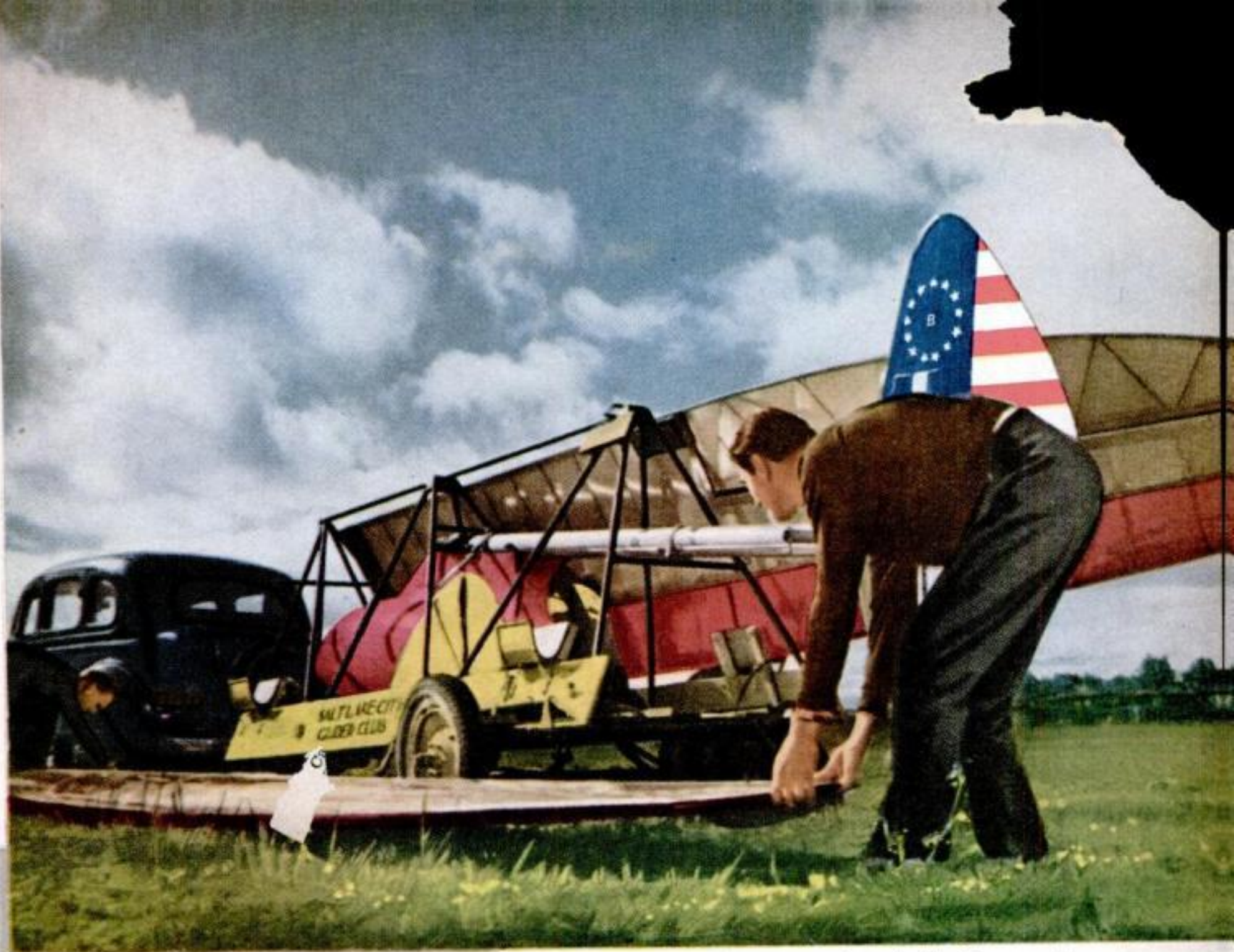




Knockdown construction makes it easy to transport gliders to suitable places for flying. These enthusiasts are assembling their craft on the desert

Members of the Salt Lake City, Utah, Glider Club unloading their sailplane from the special trailer they built to carry the homemade craft to the field





Wings ride on rubber-covered racks like those used on trucks which haul glass for large store windows

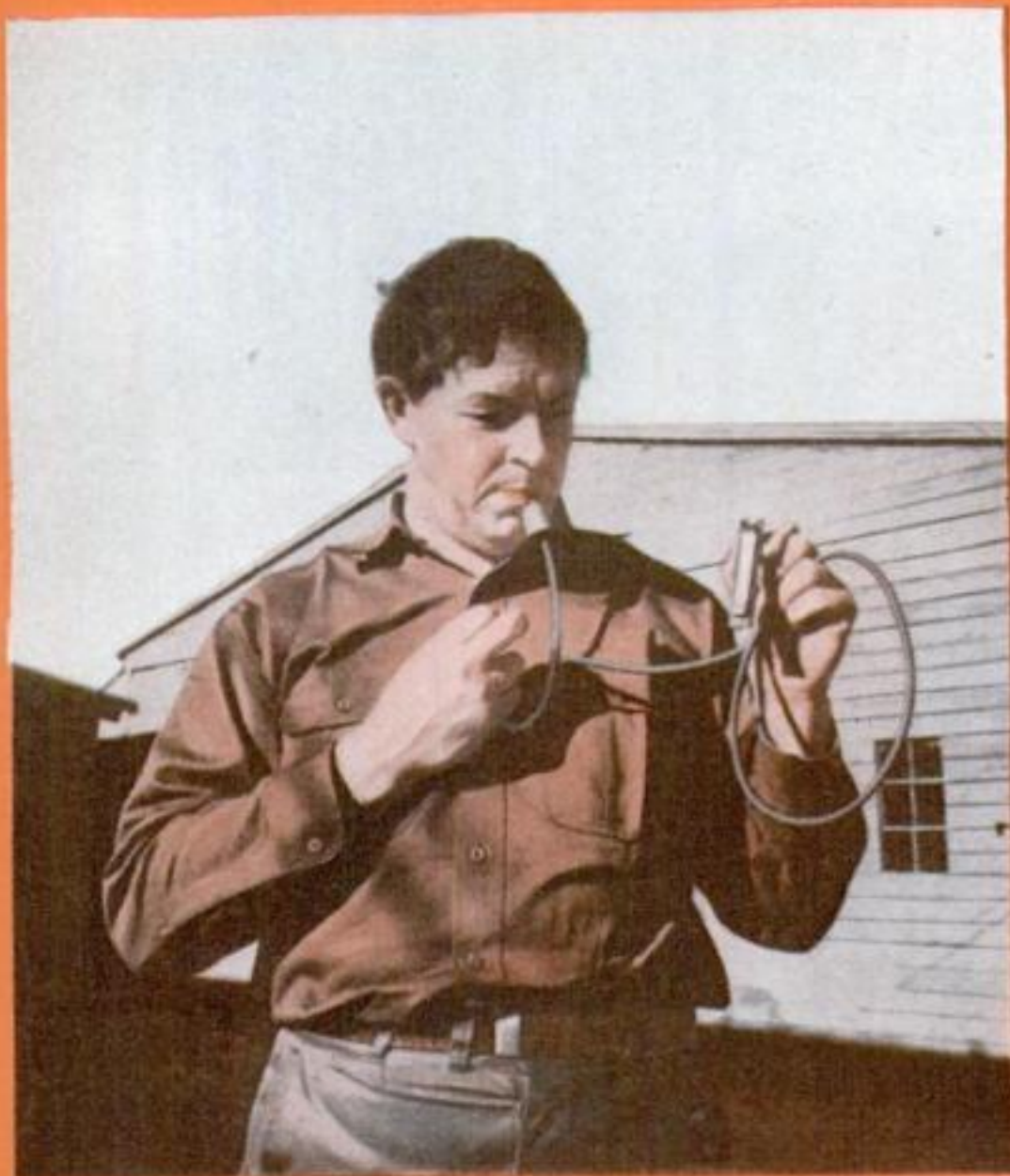


For quick starts at meets, a drum driven by an automobile engine pulls the cable





When there is a good head wind to help, a glider may be launched by a one-horsepower tow, as seen in this unusual view



Hawley Bowlus, veteran glider pilot, shows how the variometer works. This instrument enables sailplaners to find rising air currents

build, plus 150 hours, more or less, of easy labor, you acquire the parts and piece together your own sailplane. Usually, rudder and elevators come first. After assembling these, you write for the wing struts and fin. Weeks pass, and you're ready for the wings, which will roll up in the expressman's truck complete with spar and leading edge. You

need only apply finishing touches. Next, the ailerons. Finally, the fuselage and miscellaneous parts.

Now let's suppose your sailplane has been assembled and is ready to fly. Old hands at gliding say it's a good plan to take four or five hours of dual-control instruction in a small airplane. This experience will give you the feel of handling aircraft controls. At last, you drive to a level field, bolt your ship together, and start "dragging." Using an automobile for motive power, or a horse if there's a good head wind to help, you roll along the earth three or four times at a speed approaching thirty miles an hour. Next, increasing the speed to forty, you pull up forty or fifty feet, making easy right and left turns. Finally you pull up 300 feet, release the tow rope, make a complete circle, and land.

Unlike such daring veterans as Bowlus and Don Stevens, who learned to soar in rising currents by trial and error, you will need two instruments, a speed meter and a sensitive variometer, costing about thirty-five dollars. Several years ago sailplane pilots thought they required hills to deflect winds upward, thus providing rising currents of air to lift their wings. Then Dr. Carl Lange at the Massachusetts Institute of Technology discovered that "thermals," or vertical currents caused by changes in temperature, produce the same effect.

By observing the variometer you literally

can see the air rising and falling. This instrument consists of two tapered glass tubes, each containing a small bead, connected to a vacuum bottle. As the plane goes up, air rushes out of the bottle, raising the green bead; when you come down, the red bead rises. So delicate is the mechanism that even the mildest dips are registered.

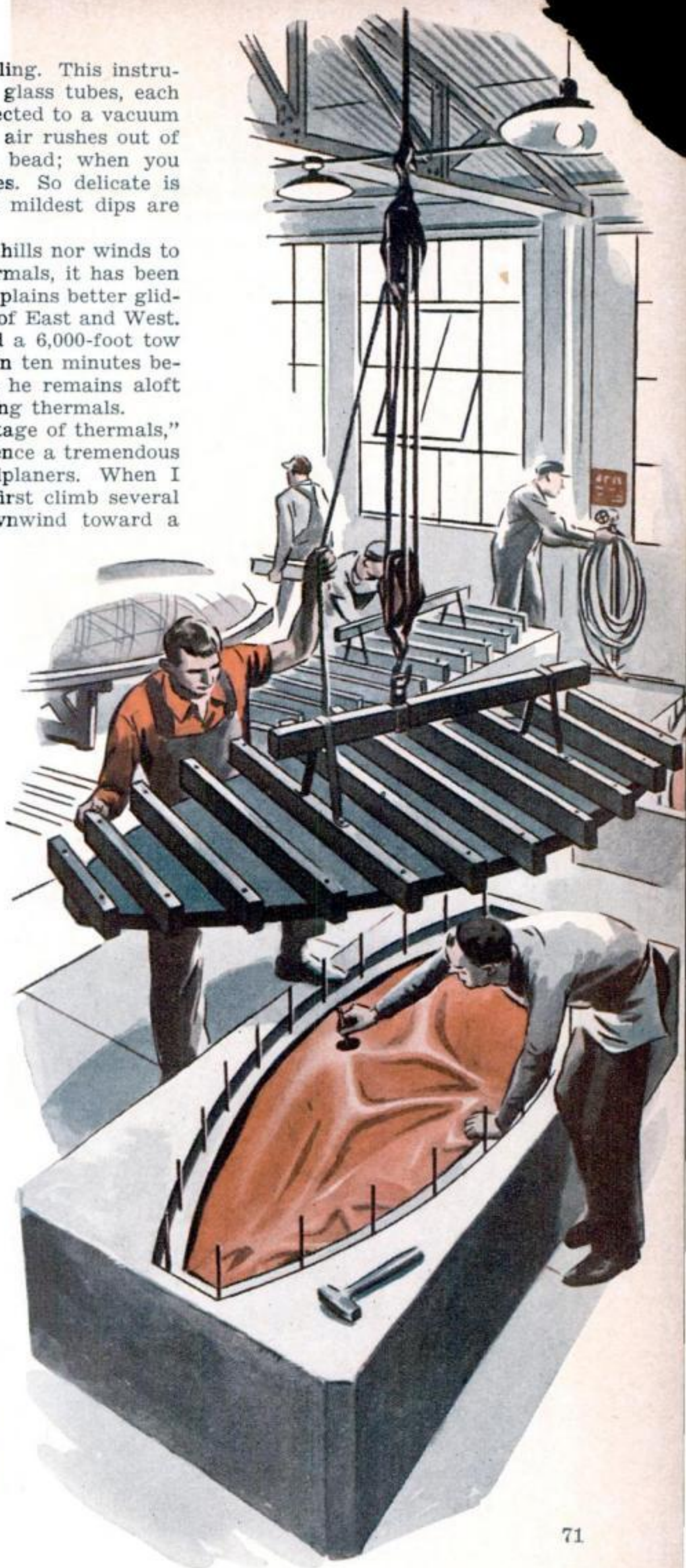
A glider pilot needs neither hills nor winds to begin his flights. In fact, thermals, it has been learned, make the midwestern plains better gliding areas than the mountains of East and West. Given a good circling run and a 6,000-foot tow rope, he can climb 2,500 feet in ten minutes before cutting loose. How long he remains aloft depends upon his skill in finding thermals.

"As we learn to take advantage of thermals," says Bowlus, "we shall experience a tremendous increase in really skilled sailplaners. When I take off from a mountain, I first climb several hundred feet, then head downwind toward a near-by valley in search for the largest possible number of these heat drafts in the shortest time. If one could find enough favorable thermals, he could glide across the continent."

Until recently, most glider pilots were contented merely with soaring to moderate altitudes and remaining in the vicinity of the home field. Taking lessons from pilots of motored planes, many now remain aloft for long periods, and frequently make "goal" flights to distant places.

Many men interested in this sport look beyond mere thrills. They see another objective — training thousands of pilots who could be transferred to the cockpits of military planes in an emergency. Army and Navy officers expect to recruit many pilots among the sailplane soarers. Perhaps, as the movement grows, America's packaged gliders will help give us a formidable force of self-trained flyers.

A scene in the Bowlus plant where sailplanes are manufactured and shipped to purchasers in kit form. Workmen are closing the mold in which laminated wood is pressed into shape for the nacelle. The pressure is supplied by inflating the rubber bag inside the mold





Aloft! Sailplane pilots now soar without power for hundreds of miles, using favorable currents of air

Girls go for gliding, too. Here is Josephine Clark, of Los Angeles, Calif., at the controls

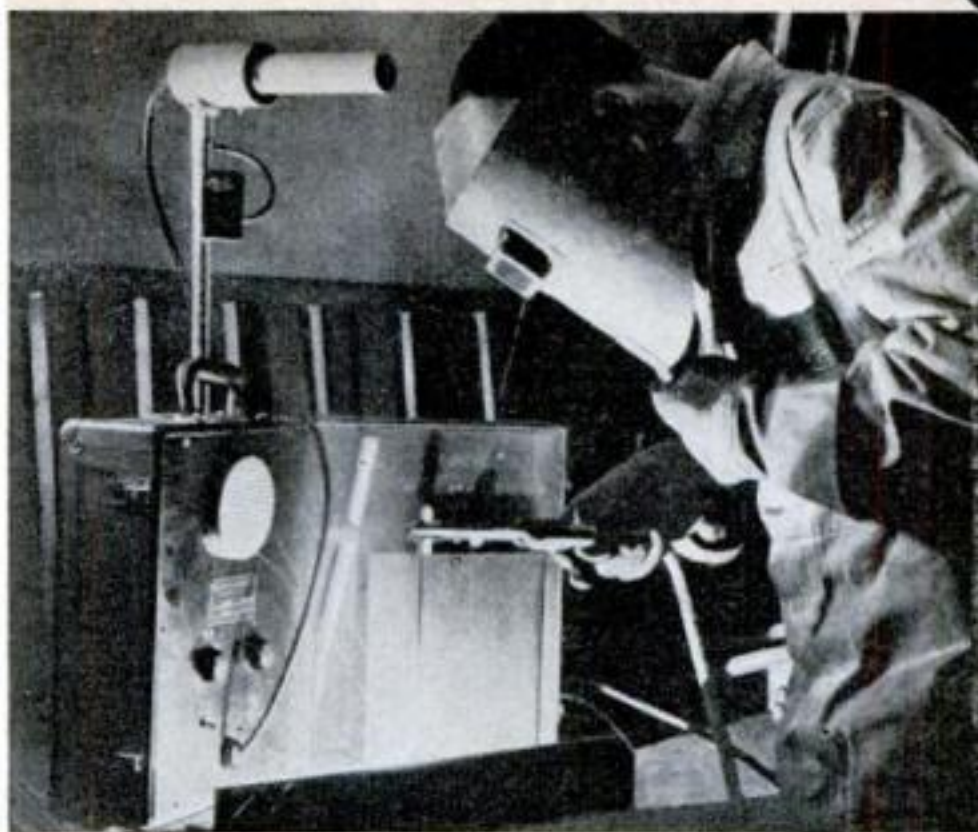


Below, a tyro gets last-minute instructions before taking off. Many beginners take a few hours of training in a small airplane in order to get the feel of it



Factory Air Sampler Protects Workers

TO INSURE the health of workers in mines and factories, experts take periodic samples of the air to determine whether a harmful concentration of dust particles exists. An electric machine, shown in the photograph at the right, does this job in an East Pittsburgh, Pa., plant. A sample of the air to be tested is sucked into a small metal tube, where the dust particles floating in the test sample are electrically charged. When the walls of the cylinder are given an opposite charge, the particles are attracted to the sides of the chamber, where they can be collected for counting and for chemical analysis.



Being portable, the dust sampler can be set up anywhere



Safety Pins Form Jewelry

DRESSED UP with gold and silver plating, the lowly safety pin is now being offered as decorative jewelry. Stores are now selling a necklace made of 180 safety pins strung on an elastic cord that fastens with a huge hook and eye. A bracelet has safety pins alternately plated in silver and gold.

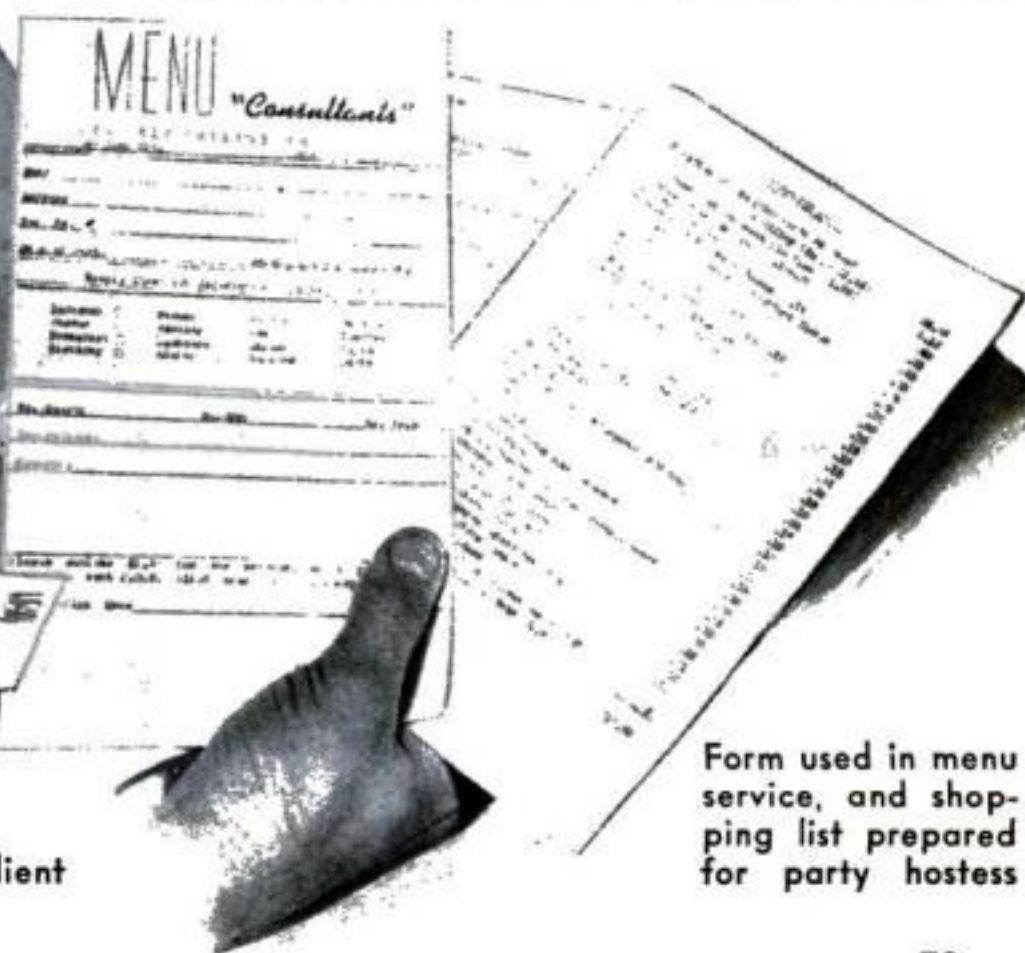
She Thinks Up Menus for Busy Wives

FOR housewives who find planning meals a chore, or for women busy with outside activities, a New York City woman has started

a novel menu-planning service. For a small fee, carefully prepared menus are sent to individual customers, including recipes for special dishes and costs of the various items. The menus are furnished for periods of a week, a month, or longer, and the service may also be used when planning a special party.



The menu consultant planning a meal for a client



Form used in menu service, and shopping list prepared for party hostess



Dropping a coin in the slot turns on the current in the shaver, which is sterilized after each use

Use of Electric Shaver Sold by Slot Machine

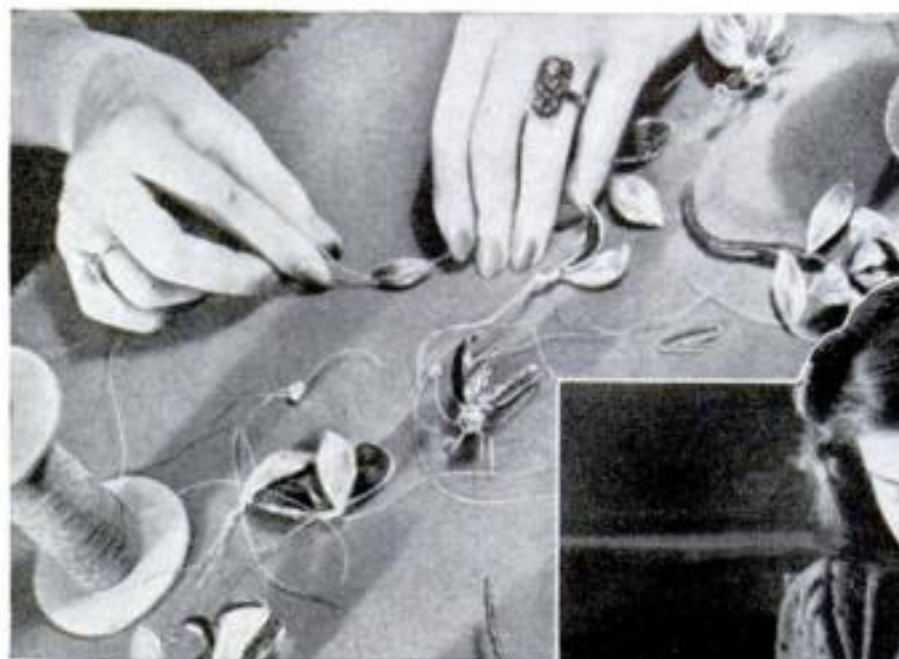
FOR men who want a quick shave away from home, a novel coin-operated machine recently introduced provides an electric shaver and a well-lighted mirror. When a coin is dropped into a slot in the machine, the current for the shaver is turned on. When not in use, the electric razor is placed in a receptacle where it is thoroughly sterilized for the next customer by rays from a built-in ultra-violet lamp. The machine is intended for installation in office buildings, bus and train terminals, and other public places.

Lightweight Sports Bike Folds for Carrying

DESCRIBED as "the bicycle built in two," a new lightweight sports bike comes apart in two sections which can be carried easily by automobile, train, boat, or bus. Since it has no horizontal crossbar, the bike can be ridden by either a man or a woman, and it is widely adjustable for size. According to the makers, it can be assembled in fifteen seconds, and taken apart as quickly.

Flowers and Insects Modeled in Wire

FORMERLY made only in European countries and imported into the United States, colorful flowers, butterflies, moths, and other winged insects made of wire, designed as decorative accessories to women's clothing, are now being fashioned in this country by a process recently patented here. Silk-covered wire is twisted into shape by hand to form individual petals or insect wings. These are then combined to form a complete insect or flower. Flower stems are added later. The wire used is available in some thirty different shades, making it possible to fashion decorative objects in a wide variety of colors.



Silk-covered wire is twisted by hand into the shape of insect wings, or the petals of artificial flowers

Right, a worker in the novel craft. Below, a flower modeled in wire

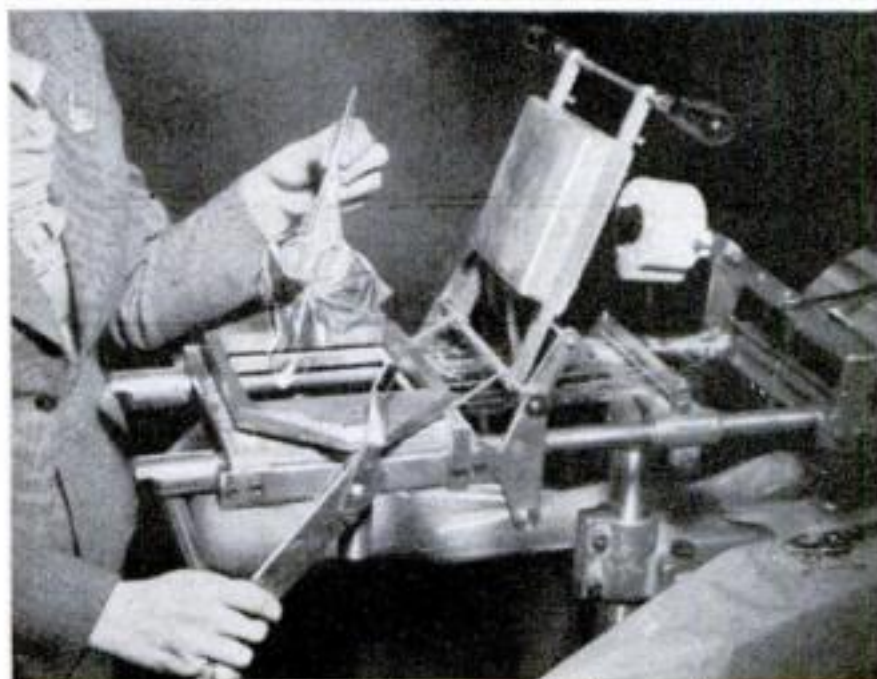
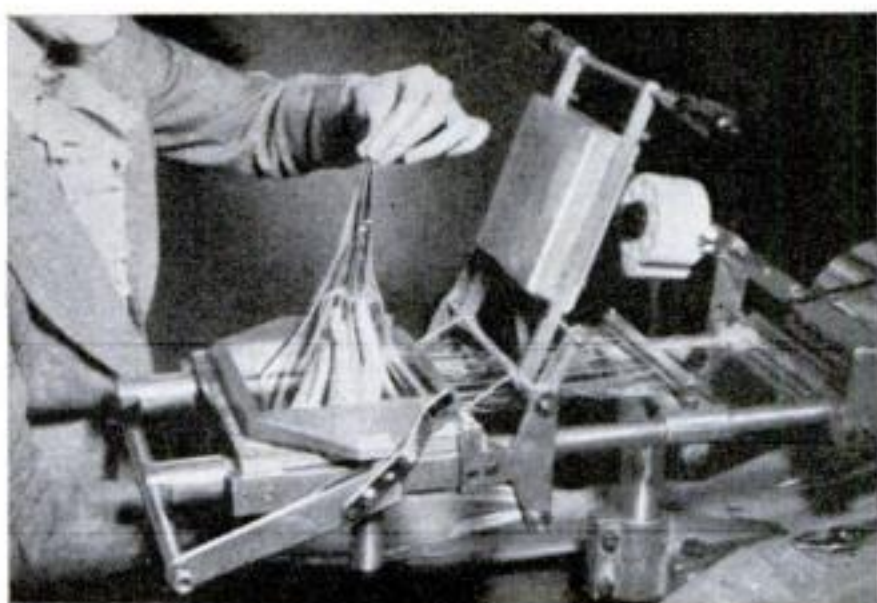


Sound Recorder Uses Fine Wire Instead of Disks

RECORDED programs that run continuously for six hours are said to be possible with the development of a new recording and reproducing apparatus that utilizes a wire nine thousandths of an inch in diameter, instead of conventional recording disks. Invented in five years of spare-time work by Harrison Gipe, engineer for a Reading, Pa., pretzel factory, the machine is reported to record sounds from the loudest shout to the faintest whisper, and reproduce them with complete fidelity—with no trace of needle scratch or rasp. An electromagnetic circuit is employed to transfer sounds picked up by a microphone onto the wire, which can be used over and over, since one recording on the wire is automatically wiped out when another is made.



Harrison Gipe with his apparatus that records sound on a wire



As an operator works levers, the heated wrapping material completely incases the pair of scissors

Device Wraps Products in Pliable Rubber Film

FOR packing merchandise of various sizes and shapes, a newly developed machine automatically wraps and seals products in a transparent, elastic wrapping material made of chemically treated rubber. Sheets of the material smaller than the product to be wrapped can be employed, since the device heats and stretches the rubber sheets.

New Use for Old Spool— as a Miniature Camera

A MINIATURE camera built into a thread spool is a recent accomplishment of John Becker, of Chicago, Ill., who has been saving spools for a period of forty years and finding a number of odd uses for them. Becker is shown snapping a picture with his odd spool camera.



Face Masks for Arctic War

ALTHOUGH he looks as though he might have been made up to play the rôle of a monster in a horror movie, the man pictured at the left is actually a Swedish soldier wearing a weird fleece mask that serves the purpose of protecting his face from the bitter winds and intense cold encountered during winter maneuvers in the northern section of his country. Note the fur-lined eye openings.



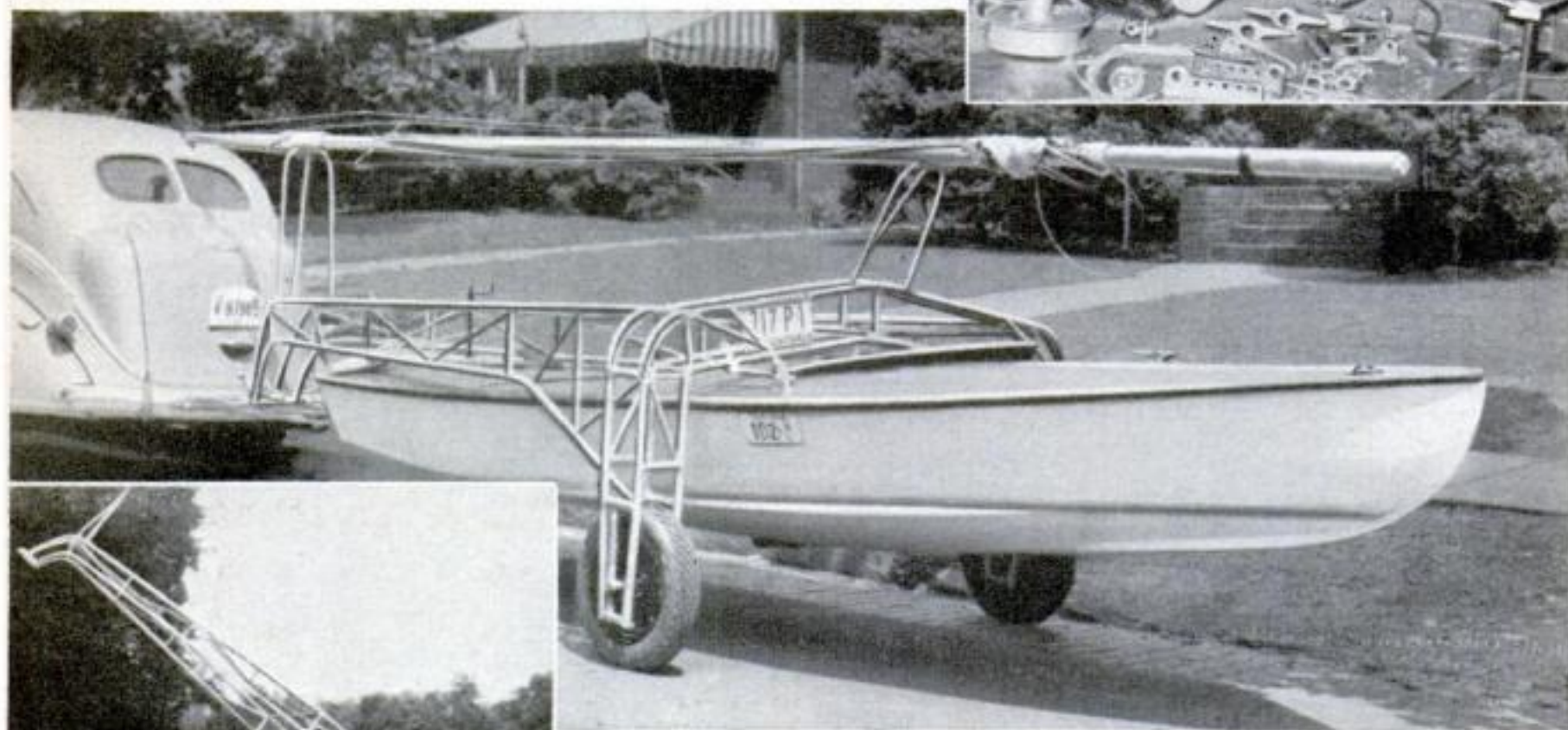
A fleece mask covers this Swedish soldier's face

Fuel Tanks for Planes Are Made of Rubber

RUBBER gasoline tanks for airplanes are a new development announced by engineers of the Glenn L. Martin Company, Baltimore, Md. Made of flexible cloth impregnated with a synthetic, gasoline-resisting rubber, the fuel bags are said to offer greater capacity, and less fire hazard than metal containers.

Trailer Lifts Sailboat from the Water

FOR transporting small sailboats to and from the water, Hilton J. Lafaye, of Akron, Ohio, has designed a novel automobile trailer that will be marketed commercially this year. Resembling the fuselage of an airplane, a metal framework serves as a cradle for the boat, which is suspended beneath it by means of built-in rings. The mast rides above on hairpin-shaped supports. Unloading and loading are easy, as the trailer can be made to launch the boat and to pick it directly out of the water. A sailboat enthusiast and home-workshop fan, Lafaye has made other innovations in the sport, including the fashioning of sheaves and other fittings from lightweight duralumin.



Sailboat slung on novel trailer, which can lift a craft out of the water as shown at left. Above, the designer, Hilton J. Lafaye, making sailboat fittings of duralumin

Royal Coach Is Modeled from Pipe Cleaners

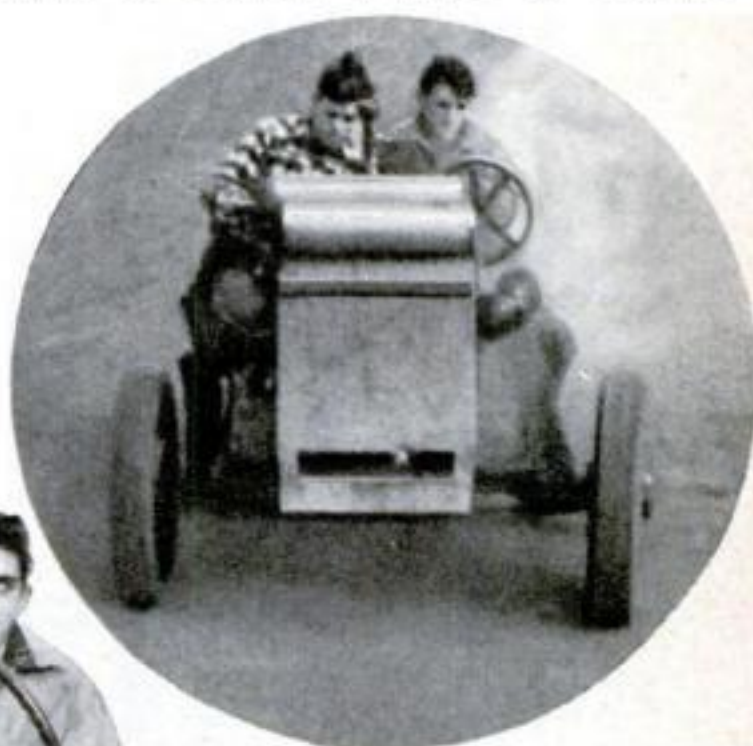
MODELING figures from pipe cleaners is the curious hobby of Dillard E. Long, of New York City, whose exhibit of a pipe-cleaner royal coach, complete with footman, driver, and horse, attracted attention at a recent hobby show. Among the many other oddities shown were tiny chairs, tables, and other furniture modeled in stale bread, and jewelry in the form of birds and insects fashioned from tree funguses. Another feature was a patchwork quilt, made from nearly 8,000 pieces of material.



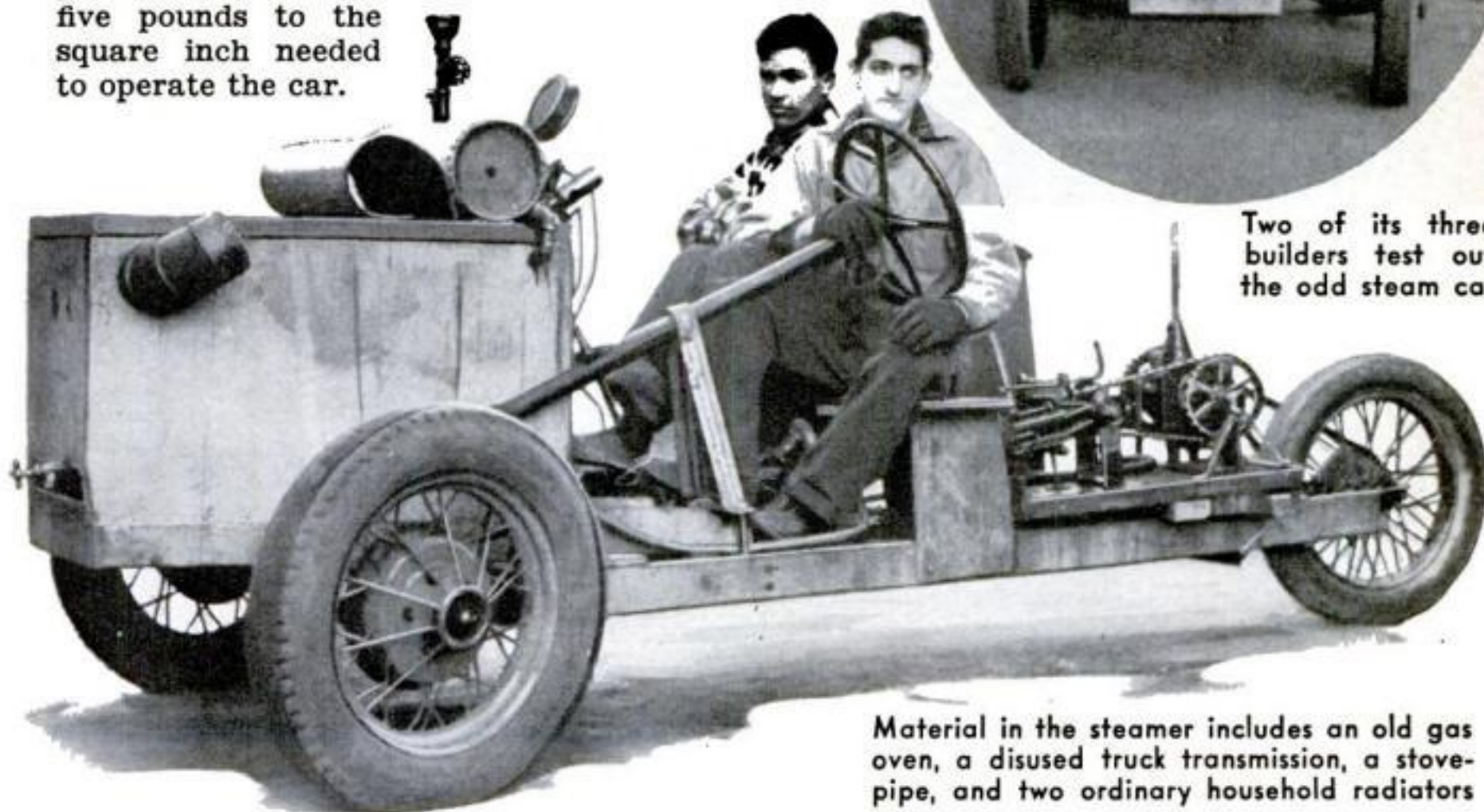
A royal coach, footman, driver, and horse made entirely of pipe cleaners

Boys Build Steam Car from Junk-Pile Parts

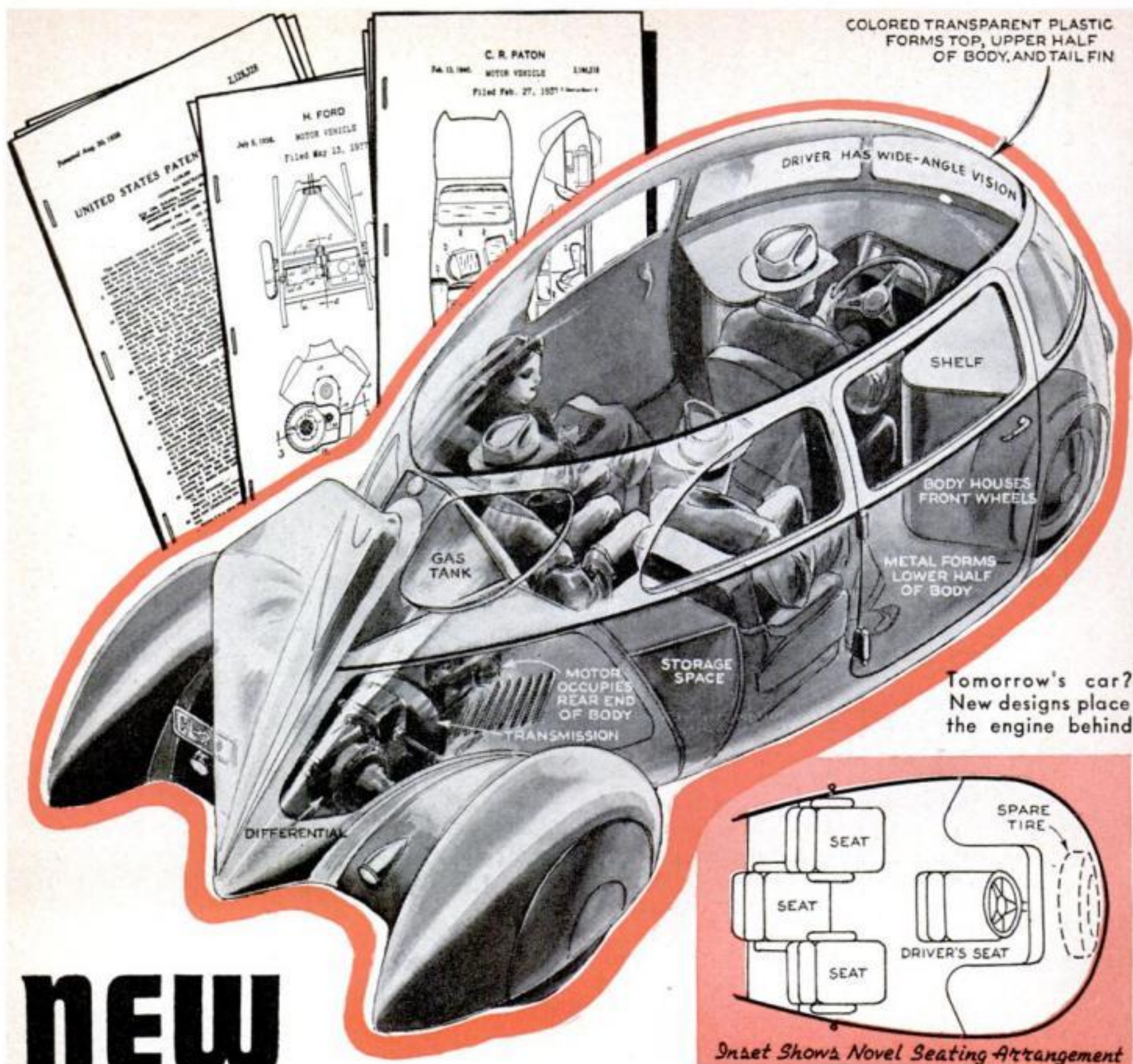
SCORCHING along the highways near Jamesburg, N. J., a steam-powered three-wheel vehicle built by three local youths constitutes a triumph of ingenuity over raw materials. For the strange vehicle is made solely from junked or discarded parts, including two home-heating radiators, the oven from an old gas stove, which serves as a firebox, and the transmission from an abandoned truck. The Jamesburg steamer boasts four speeds ahead. Wood is used as the fuel for generating and building up steam to the pressure of twenty-five pounds to the square inch needed to operate the car.



Two of its three builders test out the odd steam car



Material in the steamer includes an old gas oven, a disused truck transmission, a stove-pipe, and two ordinary household radiators



new PATENTS FORECAST



THAT car you'll be buying in 1942—what will it look like? Will it have the engine in the front or in the back? Will it be heavier or lighter, longer or shorter, more or less expensive than the car you're driving now?

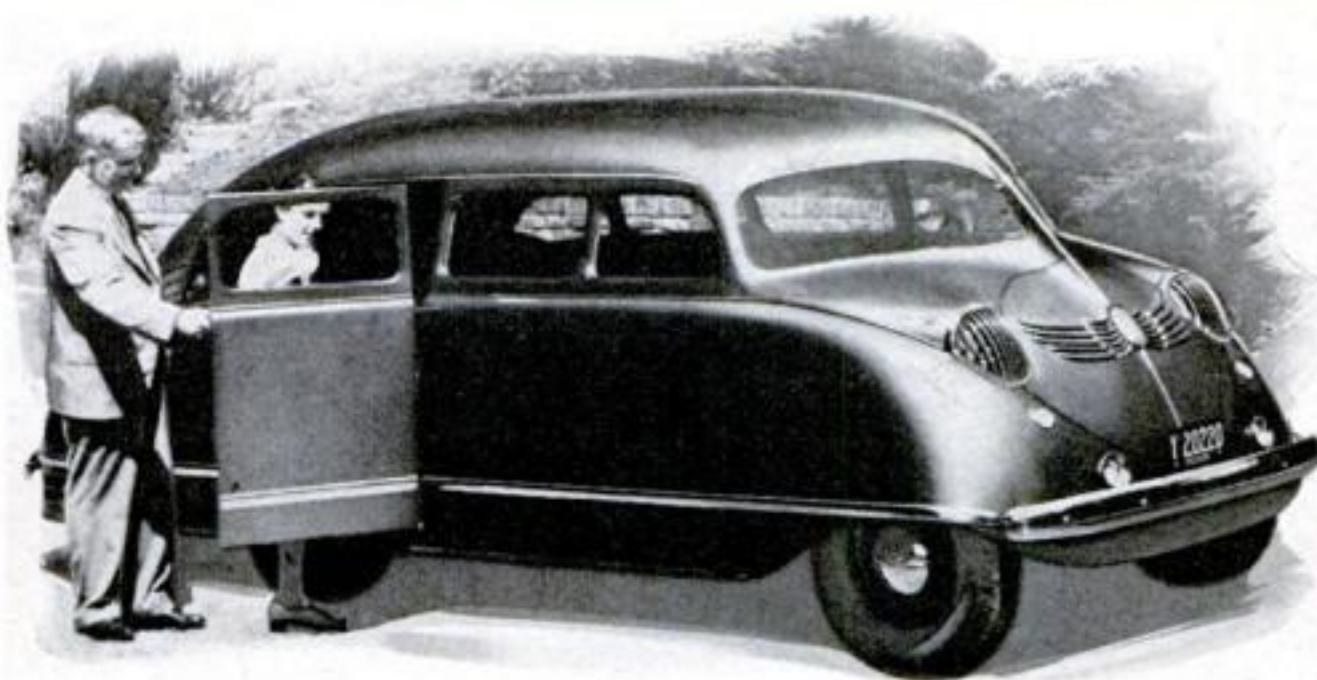
Startling is the only word for the answers to these fascinating questions, as disclosed by an automotive survey just completed by **POPULAR SCIENCE MONTHLY**. Whispers of radical changes and innovations in motor-car design are in the wind, and the recent granting of a series of important automotive patents, every one of which covers a car having its power plant in the back instead of the front, heralds the dawn of a new era in automotive transportation.

Take the advanced car design patented only a few weeks ago and assigned to a leading independent car manufacturer. Streamline from nose to tail, looking like a giant aerial bomb on wheels, this model has its engine lifted bodily from the conventional forward

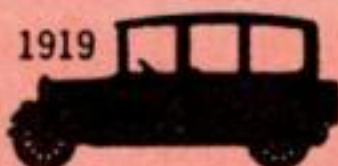
\$100 IN PRIZES FOR CAR-DESIGN IDEAS

Would you like to own a rear-engine automobile? Do you think the average car should be smaller? Or larger?

You can earn as much as \$50 by answering these questions. Write a letter of 500 words or less, outlining any of your own pet ideas on automobile design. For the best letter received before June 15, 1940, **POPULAR SCIENCE MONTHLY** will award a first prize of \$50. The writer of the second best letter will receive \$25, the third best \$15, and the fourth \$10. The editors of **POPULAR SCIENCE MONTHLY** will judge the letters, and their decisions will be final. In case of a tie, each tying contestant will be awarded the prize tied for. Address your letter to the Automobile Editor, **POPULAR SCIENCE MONTHLY**, 353 Fourth Avenue, New York, N. Y. No entries will be returned.



A pioneer rear-engine car designed by Wm. B. Stout, prominent aeronautical engineer



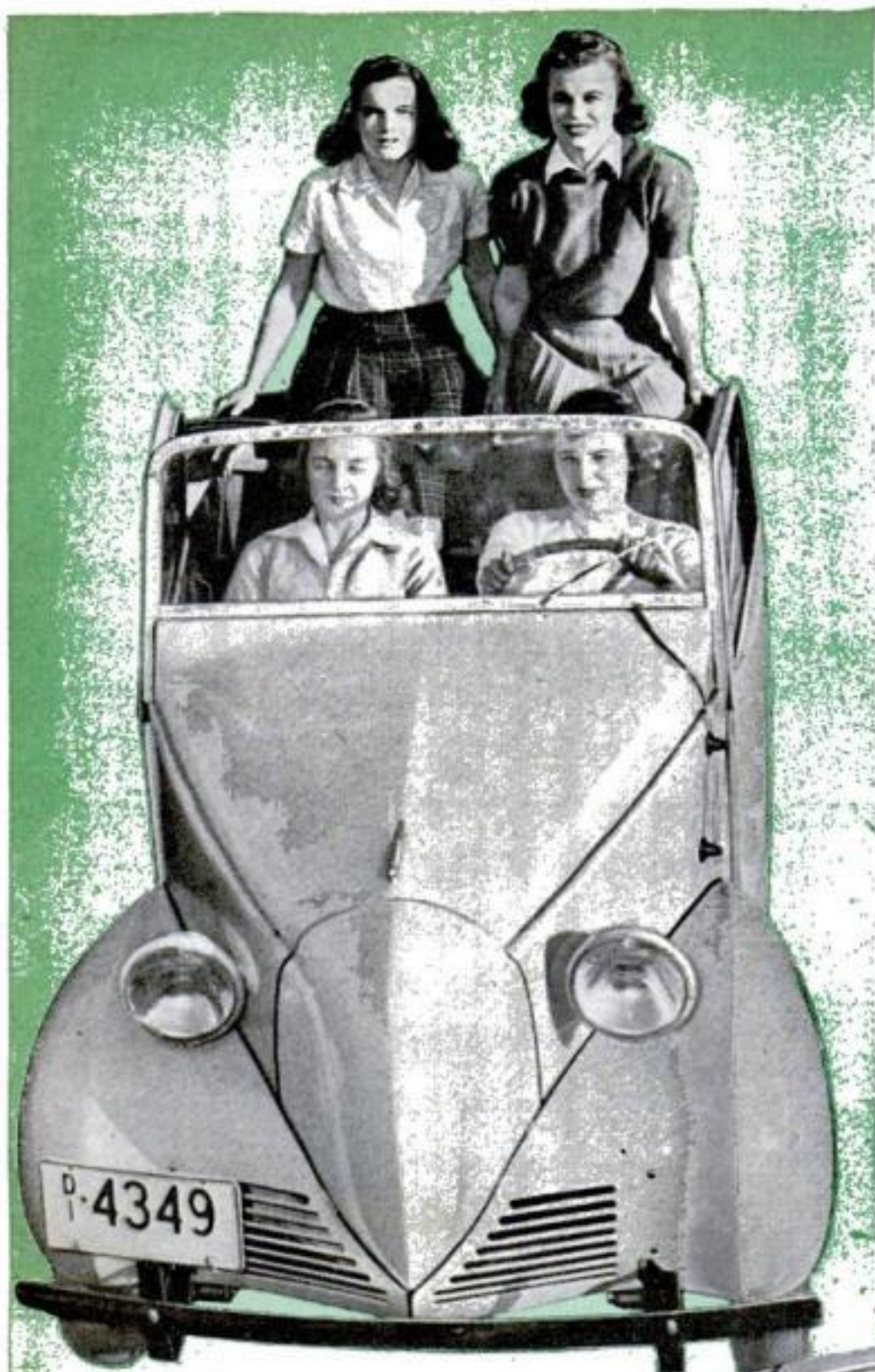
YOUR 1942 CAR

spot and set down near the rear axle in what would be a 1940 car's trunk compartment. Although still in normal alignment, the engine and transmission are operated by remote control from the single driver's seat placed up in the very nose of the car, where the operator can take full advantage of his unlimited field of vision, unhampered by any trace of bulky fenders or engine hood.

Back of the driver, in a compartment that looks as roomy as a small living room, the passengers relax in comfortable upholstered chairs, positioned nearly in the center of the car body, as far as possible from the axles, and at the point where vibration and road shock are at a minimum. Light pours in

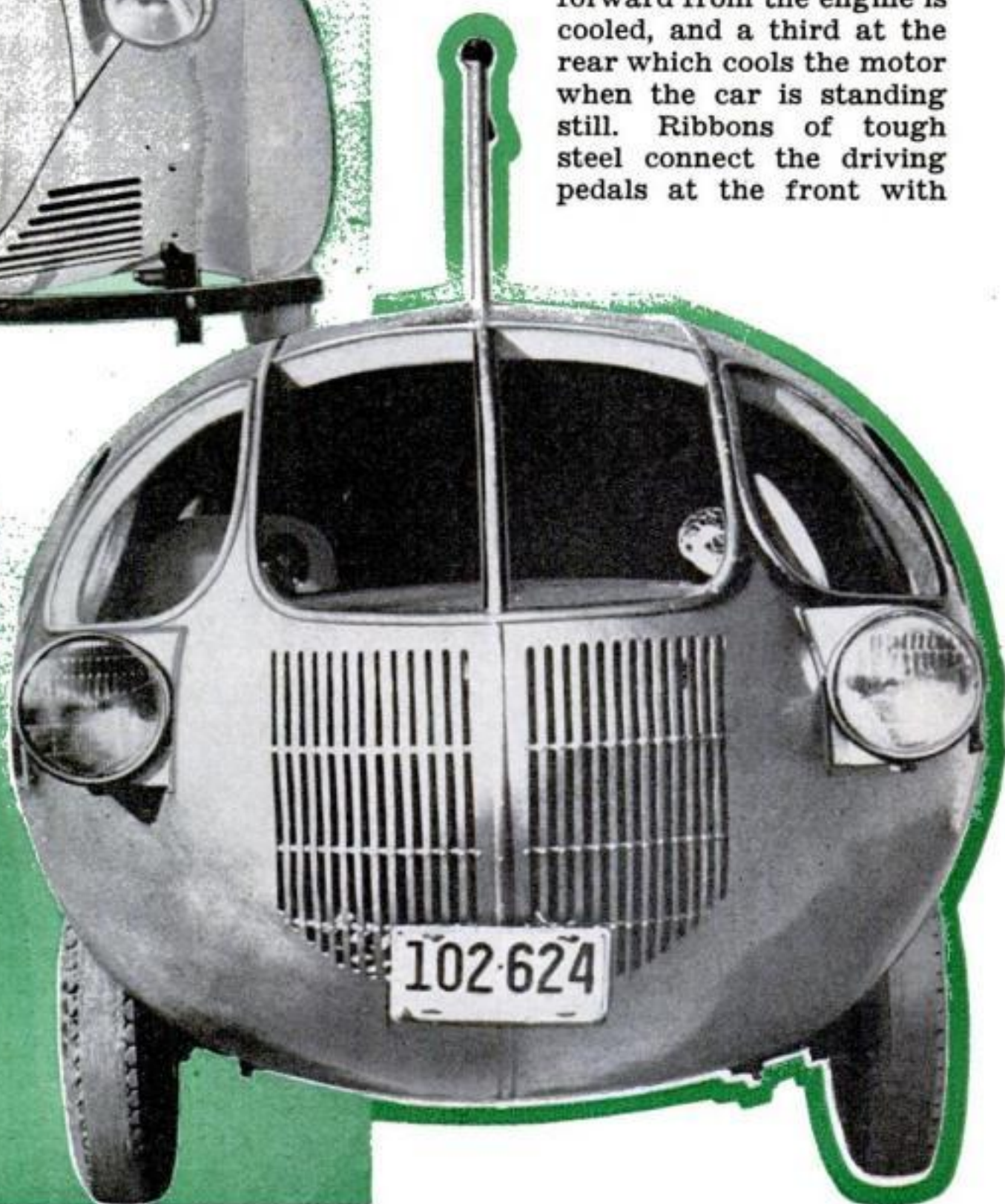
through a transparent top, and as the teardrop car purrs down the highway no trace of noise or odor from the engine in the rear has any chance of annoying those in the passenger compartment.

The dean of all American motor makers, Henry Ford, is responsible for another recent patent that foreshadows the automobile of the near future. His patent calls for an eight-cylinder engine mounted at the rear of the car transversely, or crosswise, of the frame. As Ford points out in his patent: "It is almost essential that the drive to the axles be transmitted from the center of the frame and, consequently, the engine, when mounted transversely, must be located on one side



Will automobiles get smaller? This midget, the tiniest standard car now manufactured in America, is said to make up to sixty miles on a gallon of gasoline and is easy to park

Note the wide vision provided for the driver of this twenty-foot aluminum speedster. An experimental model, this car incorporates many of the latest trends in car designing



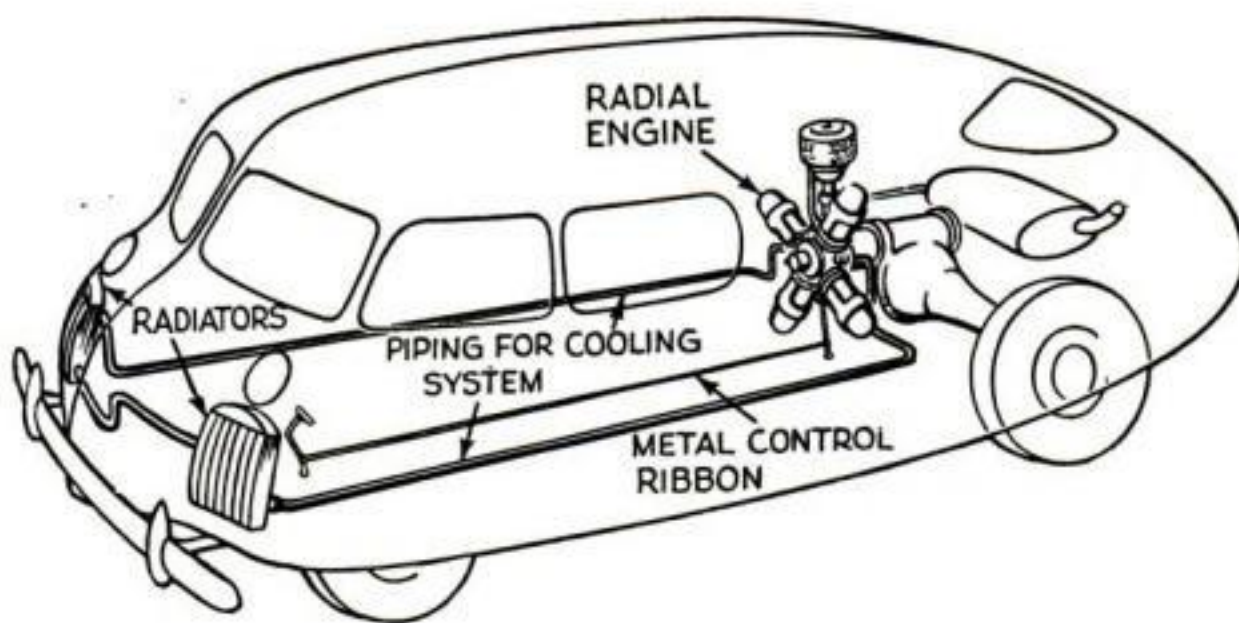
only of the vehicle. In the past this has caused the car to sag toward the engine side. The applicant has provided a unit wherein the engine flywheel, clutch, and other relatively heavy parts are located on one side of the car with the crank shaft and cylinder block on the other side to thus obtain improved lateral balance for the unit."

Still a third group of patents, assigned to one of America's largest automobile manufacturing corporations, brings to light a whole host of astounding new features. As in the cars mentioned above, this model also has its motor in the rear, but the power plant is of the radial type, with cylinders mounted in a circle around the central driveshaft like the engines that power the nation's transport planes. Instead of one large radiator for the cooling system, this car has three small ones, two being placed beneath the front headlamps where water piped forward from the engine is cooled, and a third at the rear which cools the motor when the car is standing still. Ribbons of tough steel connect the driving pedals at the front with

the power plant. And the car has no separate chassis or frame, the wheels being attached directly to the sturdy, specially designed steel body.

The power plant in this model is a unit fastened to the body by bolts. When it needs overhauling or adjustment, you loosen a few bolts, support the rear of the body on a jack, and trundle the whole power plant away on the car's rear wheels. According to reliable reports, this particular car has passed the drawing-board stage and is even now being put through tests on a midwestern automobile proving ground by engineers determined to iron out any kinks or flaws in its operation.

Other phases of automobile designing are not lagging behind this mechanical progress. Year-'round air-conditioning is on its way.



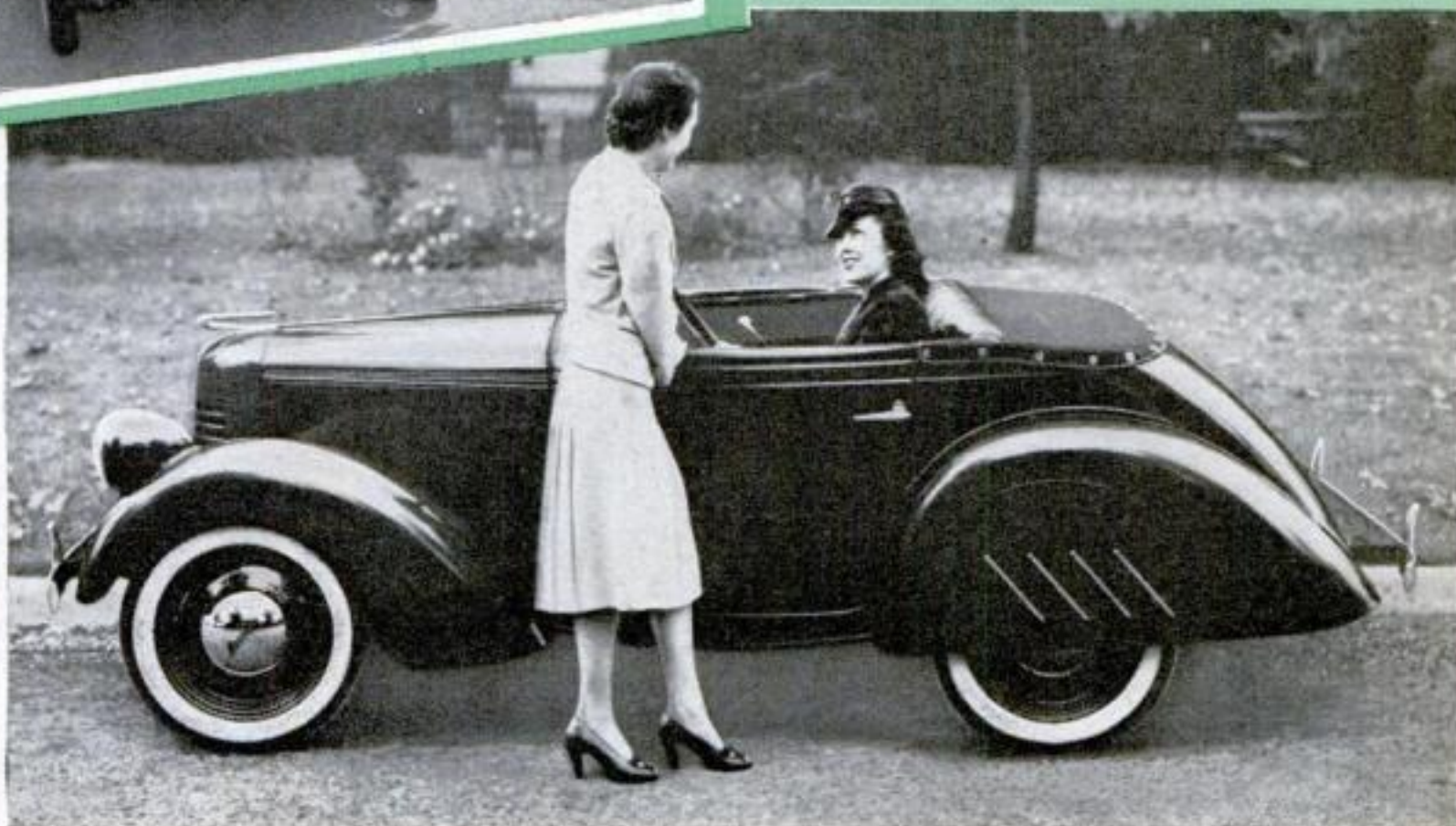
Radiators at front would cool a rear-end radial engine in this advanced design recently patented by a leading automobile maker

New alloys of steel will cut down weight while increasing strength. Painted finishes may give way to brilliantly colored plastics, strong, sturdy, and highly resistant to weather extremes. Developments in "fluid-drive" transmissions indicate that very soon a brake pedal, an accelerator, and a steering wheel will be the only controls that any motorist will have to bother with. Two-way radio installations, transparent body roofs, electrically operated doors, completely effortless steering—these and other innovations are all in the works.

And what *(Continued on page 225)*



The buglike model at left was designed and built by a California Institute of Technology professor. Below, a light car of European type manufactured here



"Pretzel-Bender" Sculpture Modeled in Strips of Clay

STRANGE and curious are the words to describe the sculptured heads pictured at the left. On display recently at a Buffalo, N. Y., art exhibit, the heads were made by Louis Dlugosz, Buffalo steelworker, who modeled them in clay by hand, and then baked them.

Chart Shows Distance Needed To Stop Car

HOW FAR an automobile travels from the time when its driver first sights danger ahead until the brakes are applied and the car is brought to a stop, is automatically figured for various car speeds by a novel analyzing chart designed for display in service stations and garages in the interest of traffic safety. Setting a long pointer at a stated car speed is the only chart adjustment required.



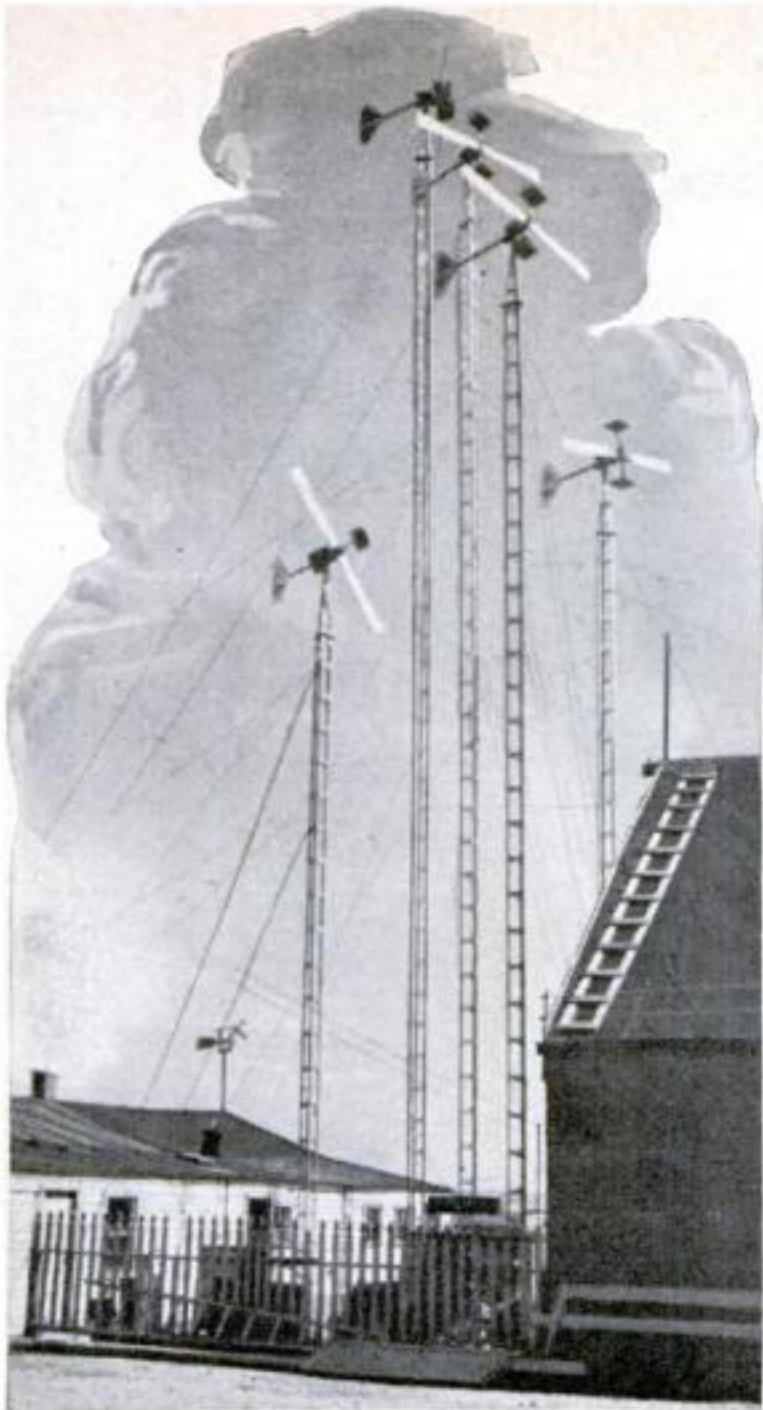
The pointer is set for any given car speed

Theater Carpet Glows Under Black Light

SPECIALLY designed for theater and sleeping-car aisles, carpets woven from wools treated with special dyes glow under invisible black light. Ultra-violet lamps equipped with filters cast invisible rays on the carpet, which gives off visible radiations, making an illuminated pathway. At the right, a glowing carpet on a theater aisle is shown under visible and under invisible lighting.



Fluorescent carpet under ordinary and, at right, under black light



"Power house" of the Pettibone, N.D., Light & Power Co. Wind-driven generators on towers at left supply current

Wind-Generated Electricity Lights a Whole Town

WIND gives Pettibone, N.D., twenty-four-hour electric service. The local utility company, owned and operated by Ray Grimm, formerly employed a gasoline engine to generate power for its forty-five users, but it proved uneconomical to run the engine twenty-four hours a day. So Grimm installed storage batteries and mounted on towers five wind-powered generators, which can be operated singly or together as required.

Dual Front Wheels for Trucks and Cars

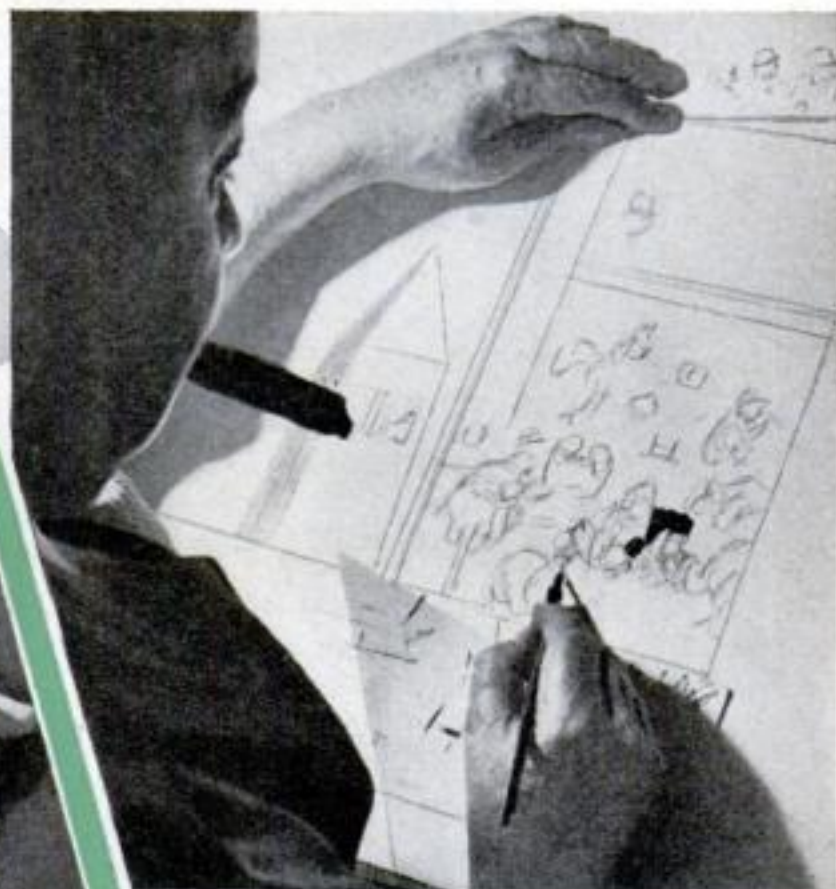
DUAL front wheels for both trucks and passenger cars are made possible by a differential mounting which allows each of a pair of dual wheels to rotate independently. Eliminating the drag produced by the tendency of one wheel to turn faster than the other, in the conventional dual-wheel mount-

ing, the differential arrangement is said to double tire mileage and to cut gasoline and oil consumption by nearly forty percent. Dual front wheels are said to reduce the danger of skidding, and to remove the peril of a front-wheel blow-out. The carrying power of the vehicle is also increased.

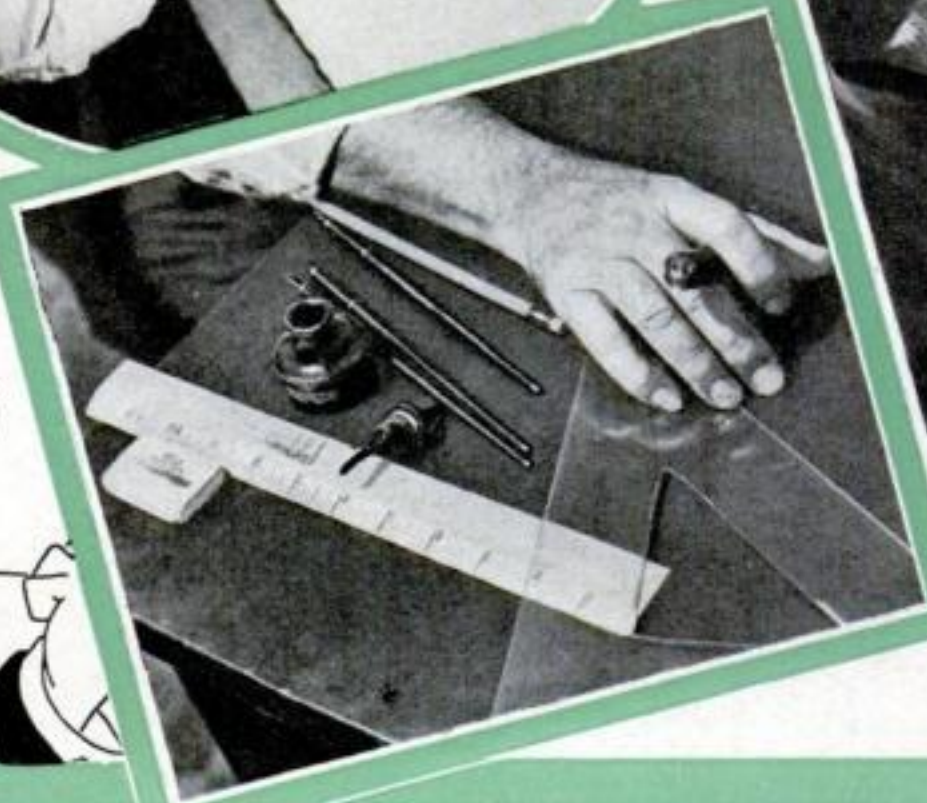


Truck equipped with differential dual front wheels. White marks show difference in rotation of wheels

MAKING



George McManus, creator of Jiggs, at work. In circle, he ponders an idea for a Sunday comic. Left, the tools of his trade, including the vital cigar. He uses the smoke to blow his ink dry



1

The cartoonist putting his famous signature on a finished comic. In beginning work, he first outlines the main portion in pencil, then inks in. The individual pictures are called "frames"



2

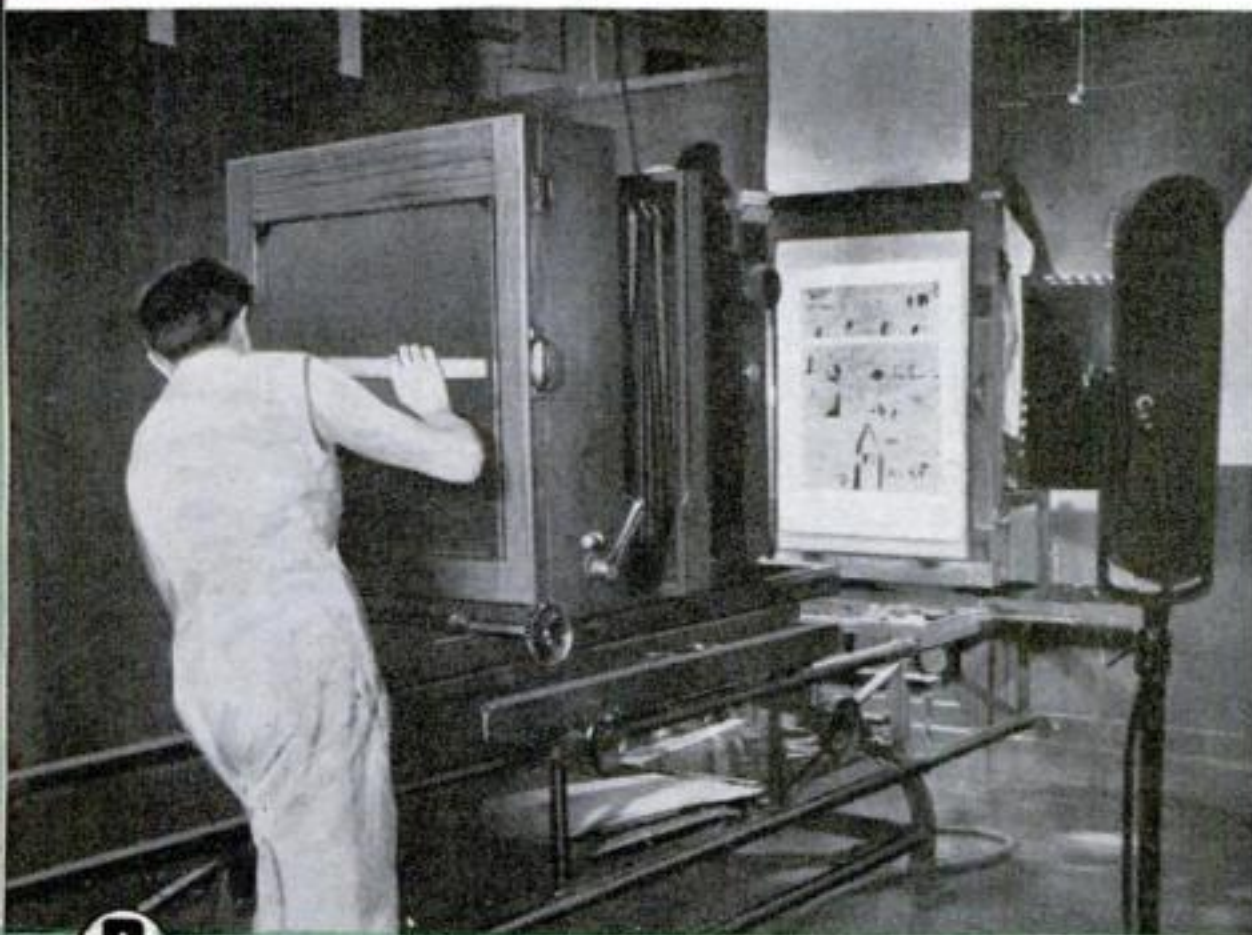
Checked and dated, the finished drawing is next photographed to size and a print is made from the negative. This print is then colored, as above, to serve as a guide for the engravers

OF A "FUNNY"

RESearch workers studying the reading habits of newspaper buyers have found out that more people look at the "funny" pages than at any other single section of a newspaper. Yet few cartoon enthusiasts realize how elaborate is the process that brings a comic from the brain and drawing board of a cartoonist through the involved stages of coloring, engraving, mat making, stereotyping, and printing to its final form as part of a published paper. To demonstrate for our readers the various steps in this intricate and interesting process, the editors of POPULAR SCIENCE MONTHLY selected one of the most popular of all comics, "Bringing Up Father," featuring those incomparable characters Jiggs and Maggie, and followed one scheduled Sunday comic page from the drawing board of its creator, George McManus, to its appearance in the New York "Journal and American" and some 500 other newspapers all over the globe. The photographs on these pages tell the story.

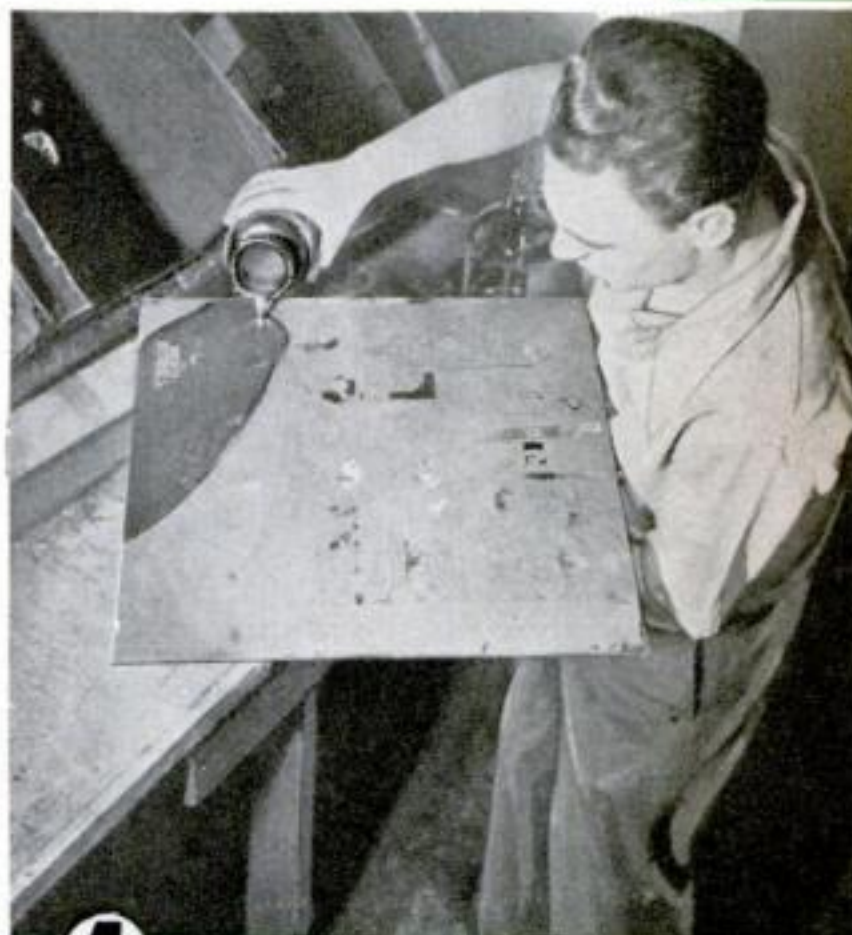
By **EDWARD W. MURTFELDT**

"Bringing Up Father" has an interesting history. It is the oldest comic in the world that has been drawn continuously by the same man—McManus has been concocting adventures for Jiggs and Maggie for twenty-eight years, without a single interruption. King Features Syndicate, in New York City, distributes it to more than forty countries



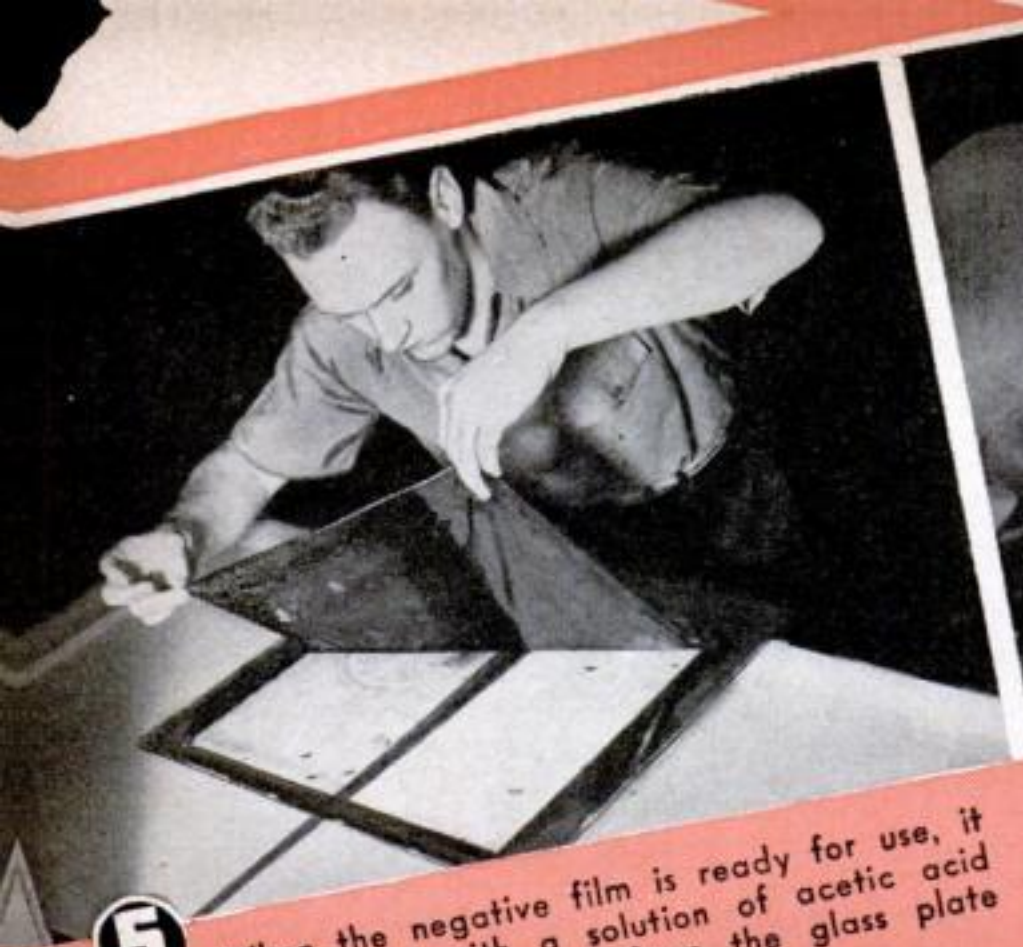
3

Now the scene shifts to the engraving plant, where the metal printing plate is to be made. The original drawing is photographed on a glass plate that has been coated with light-sensitive chemicals



4

In the developing room, the exposed plate is developed and treated to bring out the image of the drawing, as above



5 When the negative film is ready for use, it is loosened with a solution of acetic acid and carefully peeled from the glass plate



6 A sheet of zinc is now scrubbed thoroughly and treated with chemicals to sensitize it like photographic print paper



7 Then, just as in making an ordinary photographic print, the sensitized side of the zinc plate is placed against the film and exposed to a light



8 When the photographic image has been developed, the plate is prepared for the etching bath



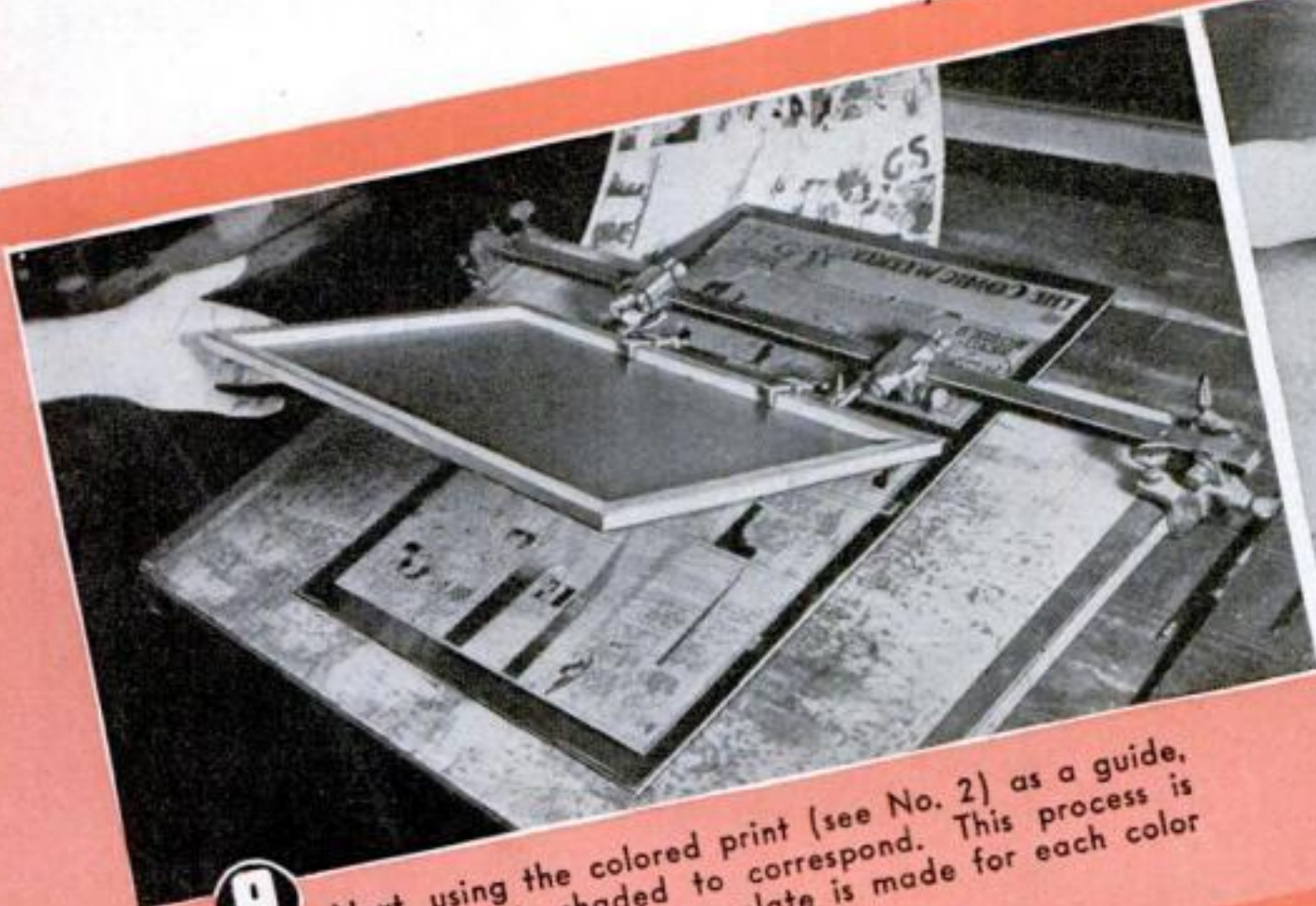
11 During the etching process, a powder is brushed on to protect the image and prevent the acid from biting too deeply



12 After etching is complete, unneeded metal is removed from the plate by an electric cutter that resembles a woodworking router



and has it translated into over twenty languages, including Javanese, Siamese, and Tagalog, a native language of the Philippine Islands. And merely because corned beef and cabbage is Jiggs's favorite dish, many butchers swear that "Bringing Up Father" has boosted the sale of corned beef.



9

Next, using the colored print (see No. 2) as a guide, the plate is shaded to correspond. This process is called "Ben Day." One plate is made for each color



10

The etching bath. Acid eats away the metal to form the image in relief



13

Jiggs's latest escapade comes to life—a sample copy of the comic, printed by hand, tests the accuracy of the plates



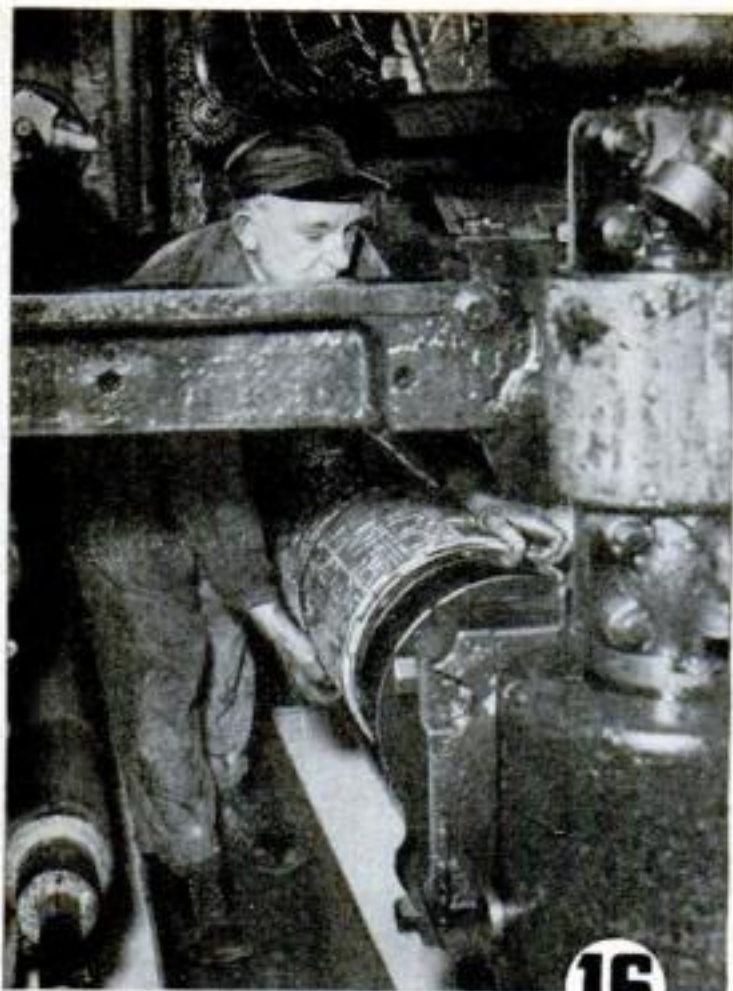
14

Finally, cardboardlike impressions, known as "mats," are made from the finished plates. Being light . . .

15

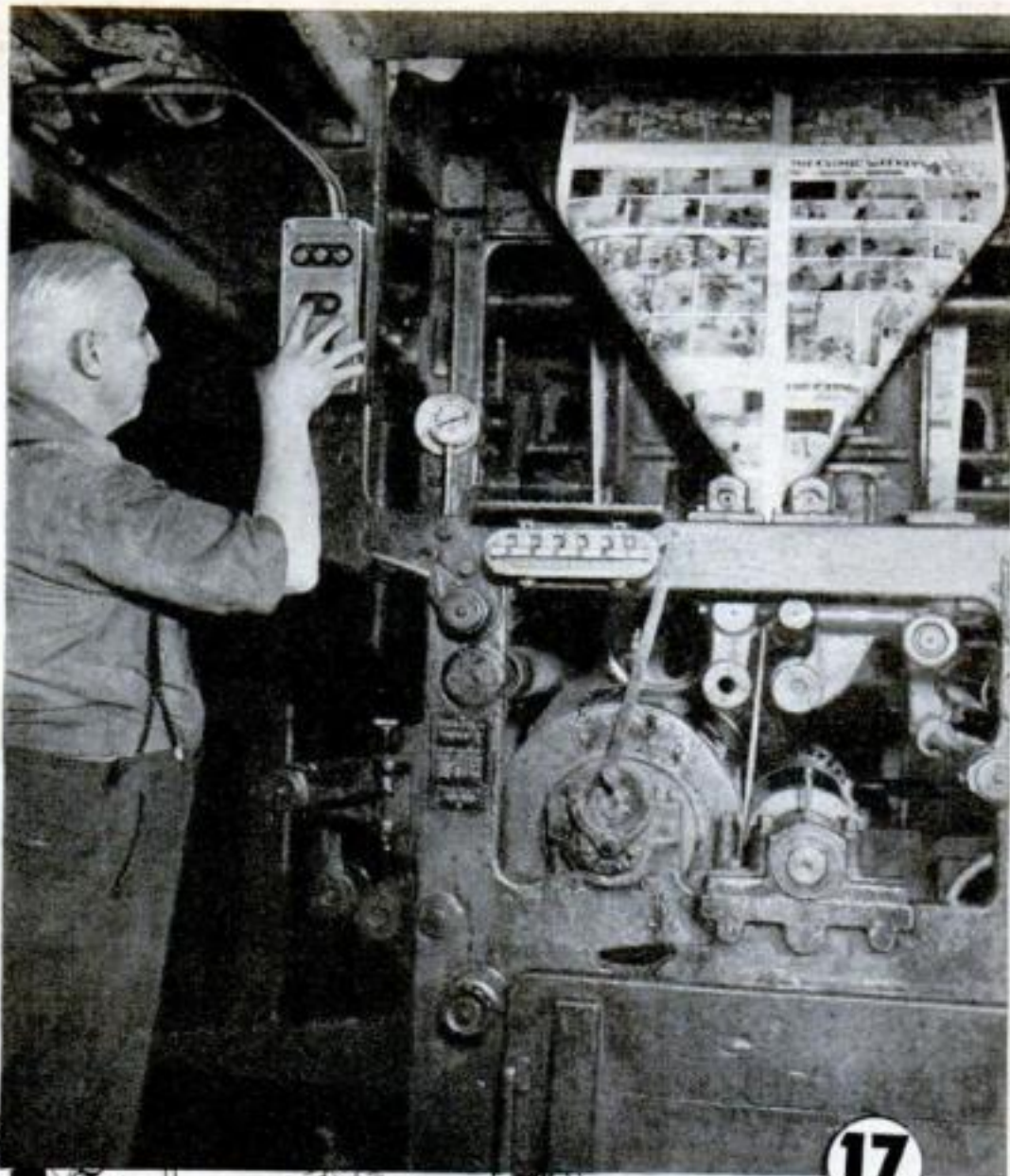
. . . and inexpensive, the "mats" can be mailed to every newspaper that publishes the comic. The mats are used as molds for casting the semicylindrical metal plates which do the actual printing. Here a plate is coming out of the casting box





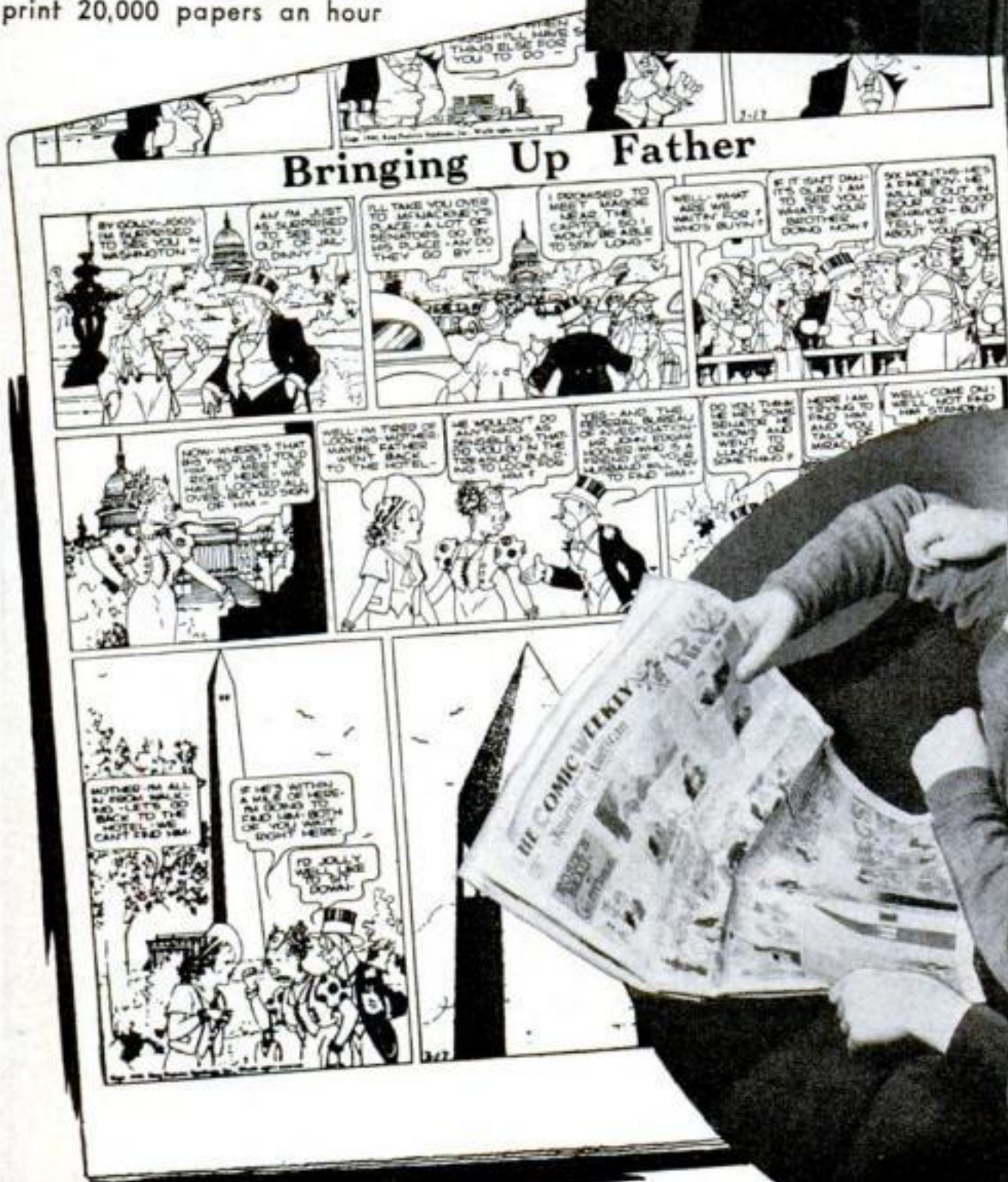
16

Adjusting one of the plates on the roller of a huge newspaper press. At full speed, presses like this one can print 20,000 papers an hour



17

The press starts to roll. Printed comics are seen coming off the rollers, to be folded and stacked mechanically. At left is the finished product; below, two ultimate consumers



Explorers Can South Sea Swing

SOUTH SEA ISLAND swing music, recorded in the radio room of an exploring ship fifteen or twenty miles from the spot where jungle musicians are playing, will be collected by the Fahnestock Expedition which recently sailed from New York City. The recordings later will be made available to conservatories, colleges, and museums. They are expected to provide new rhythm patterns for American song composers. On its two-year, 40,000-mile voyage, the expedition will carry on long-distance radio experiments and gather material for bird-habitat displays at the American Museum of Natural History, as well as collect the music of remote islands. Stops for the latter purpose will be made at the New Hebrides, Torres, Banks, Santa Cruz, and the Solomon Islands. Equipped with 3½-pound port-

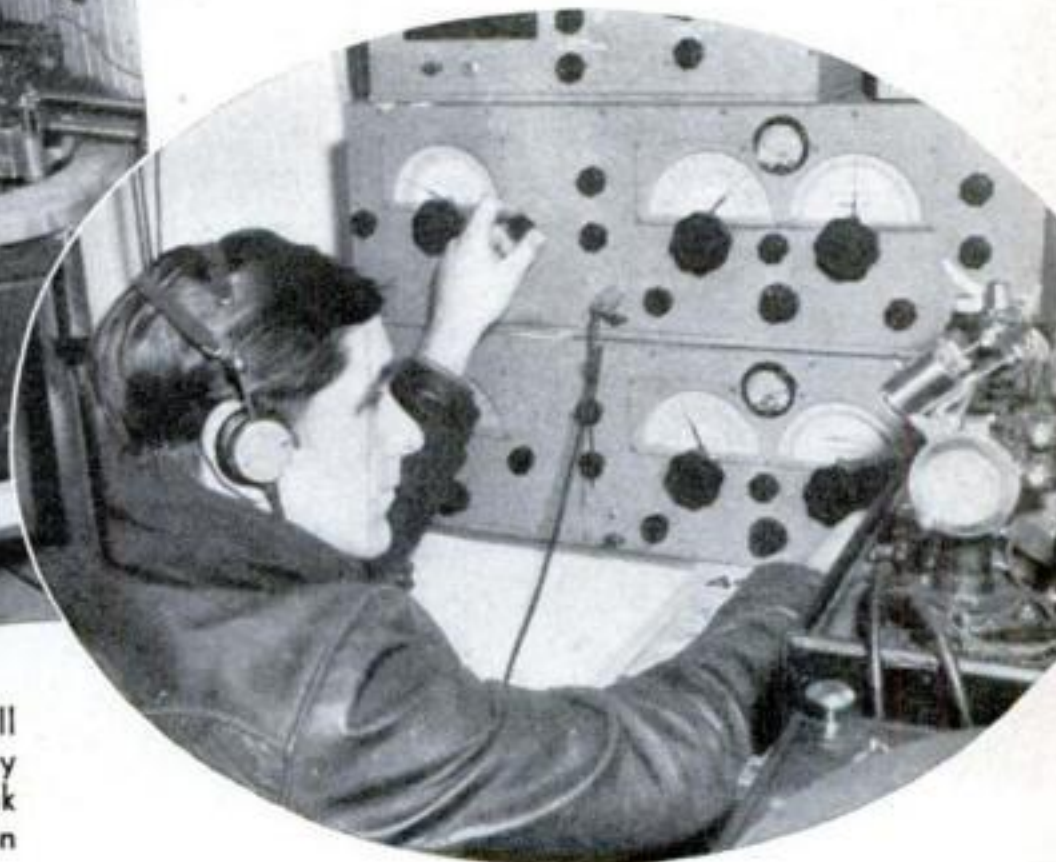
able transmitters, the explorers ashore will broadcast jungle music by radio to the ship where Frank O. Chesus, recording technician, will "can" the primitive rhythms.



"Director II," exploring ship of the Fahnestock Expedition, being made ready for her voyage to the South Seas to record native island music



This shipboard recording apparatus will "can" primitive rhythms transmitted by radio from the shore. At right is Frank O. Chesus, the party's radio technician

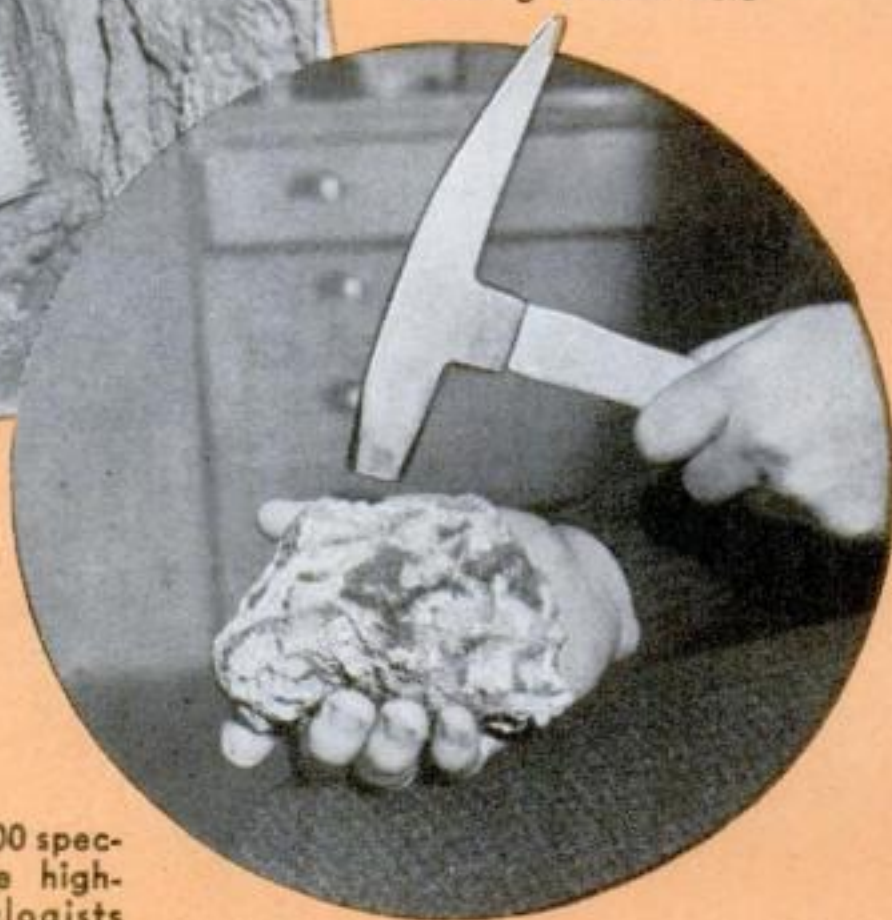
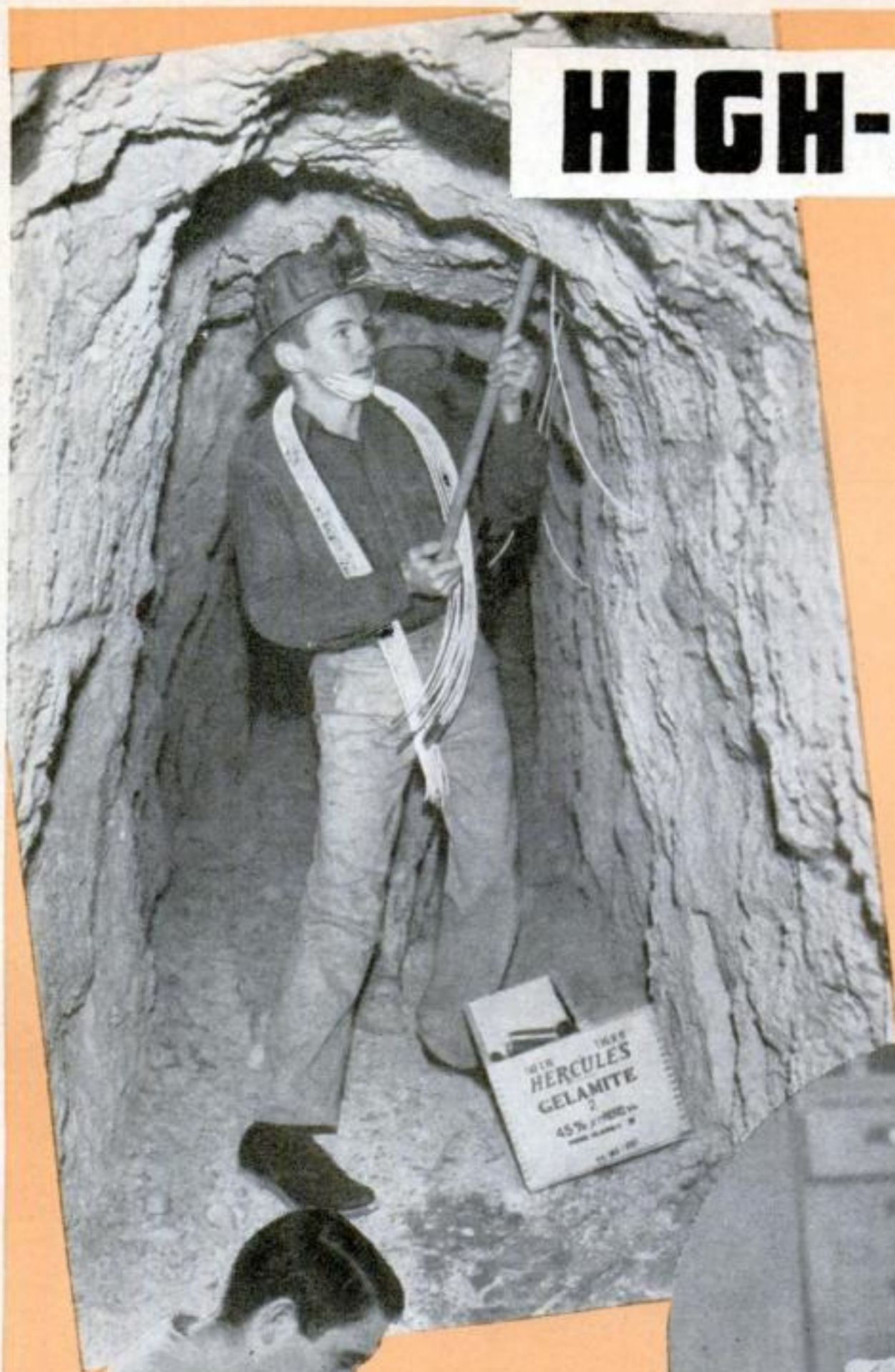


HIGH-SCHOOL

Mineralogy Class
Trains Students
To Recognize the
Riches That Lie
All Around Them
Upon the Desert

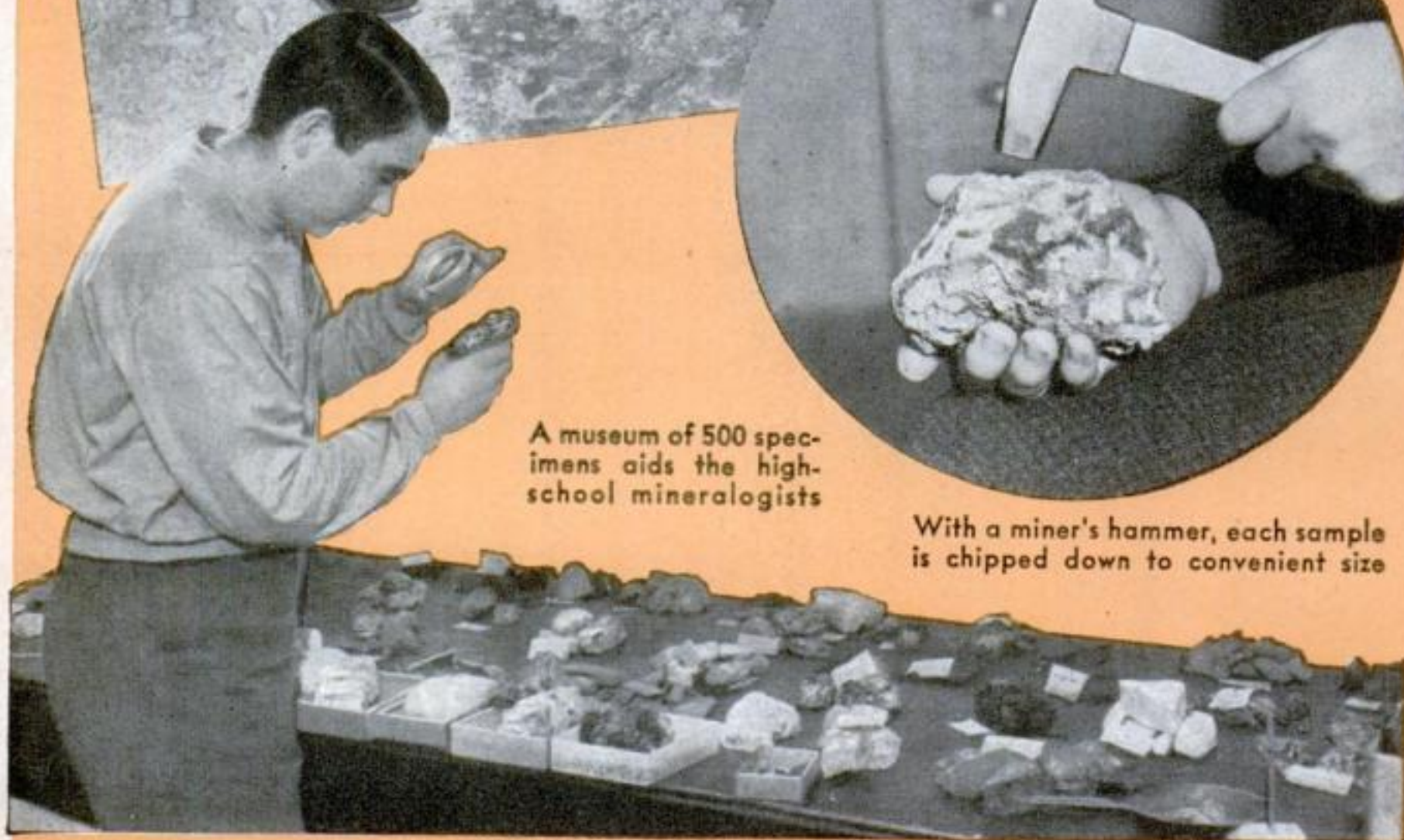
By
**JOHN E.
LODGE**

Jack Beyer, sixteen-
year-old prospector,
loading a blast hole



A museum of 500 spec-
imens aids the high-
school mineralogists

With a miner's hammer, each sample
is chipped down to convenient size

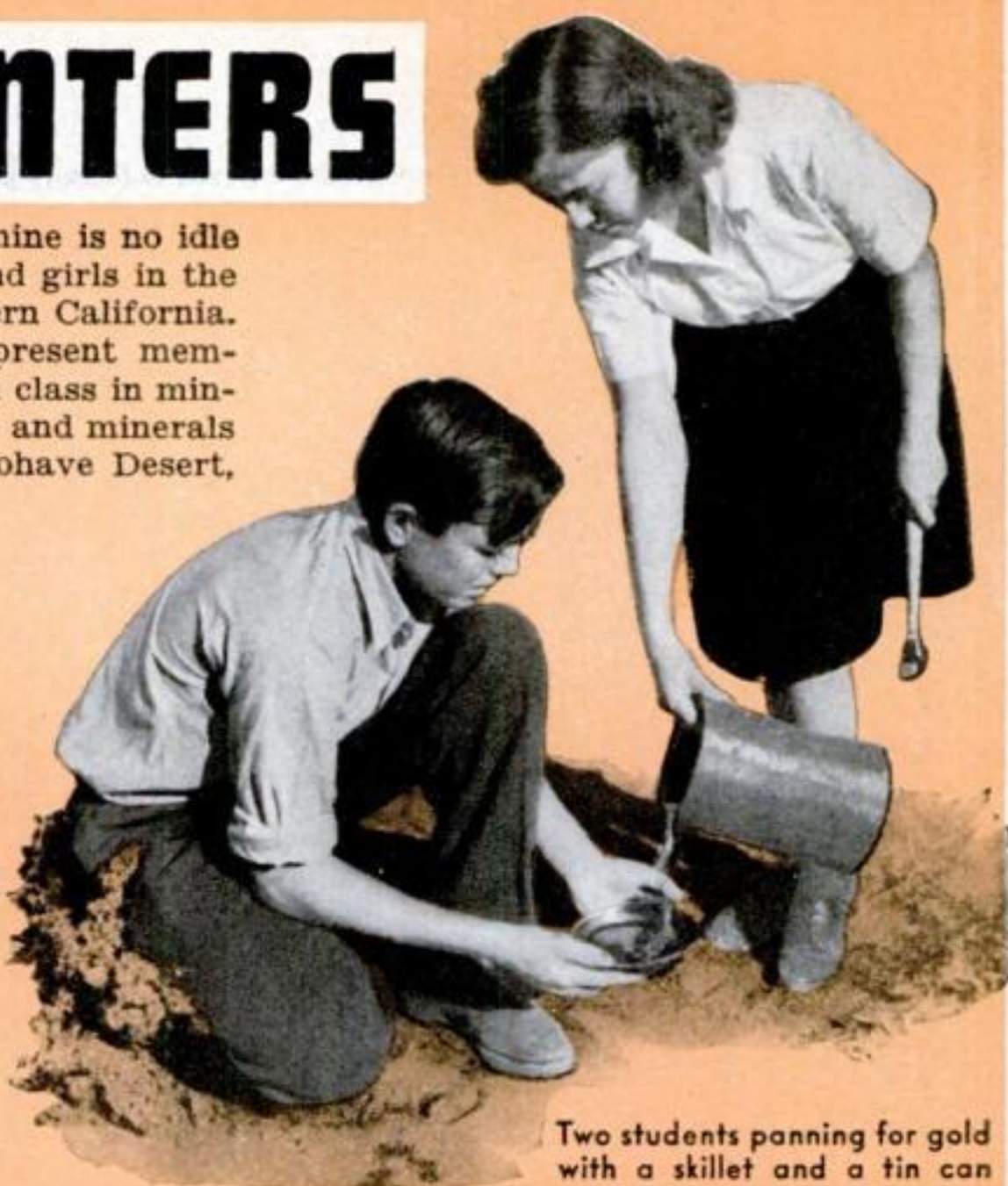


GOLD HUNTERS

STUMBLING over a gold mine is no idle daydream for 250 boys and girls in the Antelope Valley of southern California. These youngsters, past and present members of an unusual high-school class in mineralogy, can identify 200 rocks and minerals around their homes on the Mohave Desert, stake mining claims, pan gold, pick out high-grade ore, and figure to a gnat's eyebrow the proper percentage to pay for a lease. Already several have earned comparatively large sums by blasting minerals from the earth and by selling leases to older miners.

More than 100 mines, including the famous Golden Queen, Cactus Queen, Tropico, Lida, and Standard, have yielded millions in gold and

On a desert field trip, instructor Robert P. Durbin shows how to recognize gold ore in a rock



Two students panning for gold with a skillet and a tin can



other minerals almost at their doorsteps. How can rocks bearing rich minerals be identified? What makes a mineral rock different from any other? Why is gold found in this valley? They ask themselves these questions, then proceed to find the answers.

Each morning, on horses and in fourteen large busses, the young prospectors and 800 other students ride as far as seventy miles to school at Lancaster. In late afternoon, they scatter to their homes in a school district twice as big as the State of Connecticut.

This unusual class started five years ago, and was born of the misery of a boy who failed to recognize a fortune while walking on it. He was herding cattle

during the summer, throwing an occasional rock to while away the time. That autumn a grizzled old prospector, walking along a trail, was amazed to see gold sprinkled over the ground. For months, miners literally scooped up gold ore with their hands. Then Roy A. Knapp, district school superintendent, heard the youth's story. "From now on," he decided, "every pupil who wants to learn how to recognize gold ore may do so."

Five hundred specimens of various ores were quickly gathered and formed into a museum of minerals. Youngsters were invited to study them, to be trained for opportunity right at home. Nearly any day, you can see a score or more on the desert armed with miners' hammers, tin pans, buckets, and water.

Jack Beyer, who is sixteen, engages in high-grading around established mines and selling promising leases. At odd times, he has taken \$600 in dust from one mine, to say nothing of \$1,400 from leases.

With their father, Herbert and Kenneth Spencer have leased an old mine which they took over after larger operators had given it up. "We knew it contained rhyolite porphyry," explains Herbert, "which is a common ore-bearing rock." While exploring the tunnels and drifts, they saw several small stringers six inches wide. With a jackhammer drill, they run down these stringers, lift the ore 300 feet to the surface in a bucket and send it out for milling. At twenty-five dollars a ton, this ore keeps the boys



Young prospectors arriving on the school bus. They carry ore samples for analysis in the laboratory. In the upper picture, a specimen being tested for gold

in school and their family in a comfortable desert home.

Gene and Tom Smith are interested in nonmetallic minerals, and visualize the time when they will go to work with their father, mining and refining borax. Right now they are studying the industrial process, taking samples of borax during each stage of refinement, learning how it changes and why the original glistening white solid becomes a fluffy powder with many uses.

Some of the boys look on their home valley with the eyes of scientists. Dick Cheney built a model of near-by Amboy Volcano, a crater long extinct. He hopes soon to drill out specimens for further study. Bob Kreigh walked and rode over the valley, examined the hills closely, and compiled four erosion sketches which show all the important mountains and washes. "Minerals rode floods down many of these," he declares. "Perhaps they've come farther into the valley than some folks think."

Every day some youngster jumps off the bus with a sack of minerals new to him. In the school laboratory he takes a small piece from each sample. If he suspects he has gold, he grinds the rock, places it in a test tube with nitric and hydrochloric acids, and carefully brings the mixture to a boil. He adds tin filings, and if the liquid takes on a purplish hue, he knows he has found gold.



With a blowpipe, a boy miner literally smelts a piece of ore for beads of the precious metal.



One-Arm Canoe Paddle Leaves Hands Free

A CANOE paddle that can be manipulated with one arm is a recent invention that should prove a boon to hunters, anglers, and woodsmen. Made with a conventional blade and handle, the paddle is provided with a hook-shaped, semi-rigid strap that is hinged to the handle. With the curved strap hung over his arm, the sportsman is free to use both hands for casting a line, fighting and landing a fish, or aiming a gun, but can instantly bring the paddle into use, simply by grasping the lower part of the handle, as shown in the drawing and in the photograph reproduced above. Adjustable to any size arm, the paddle may also serve as a boat hook, since the blade may be grasped in one hand and the strap employed as a hook. It is said to be specially handy for holding a boat while fishing with live bait.



Softball Glove Has Palm Pad for Easy Catch

TO MAKE it easier to catch and hold the ball in one hand, the new softball glove seen in the photograph directly below is provided with a horse-shoe-shaped pad on the palm, which provides a deep pocket for the ball to nestle into, and allows the hand to get a firm grip.

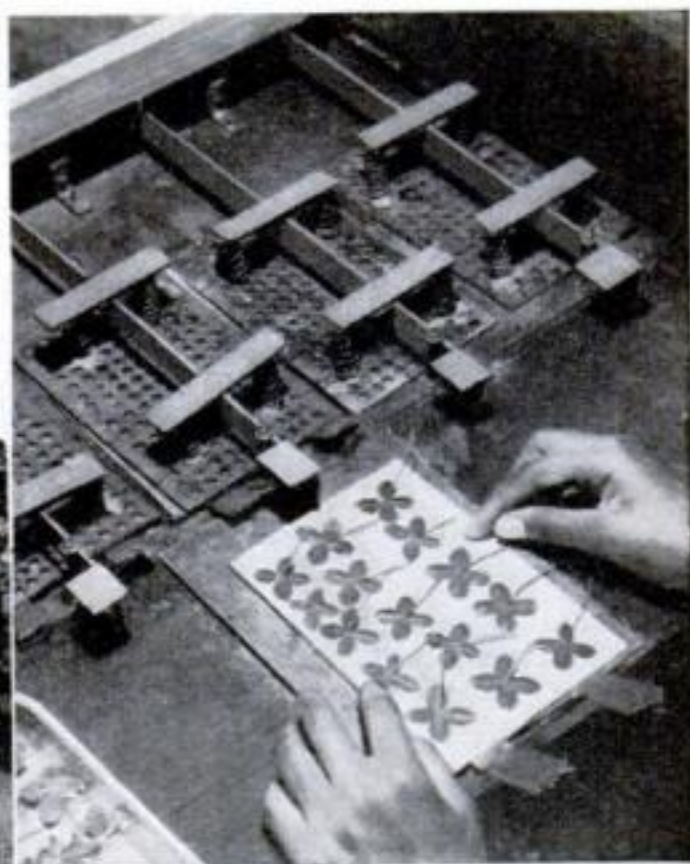
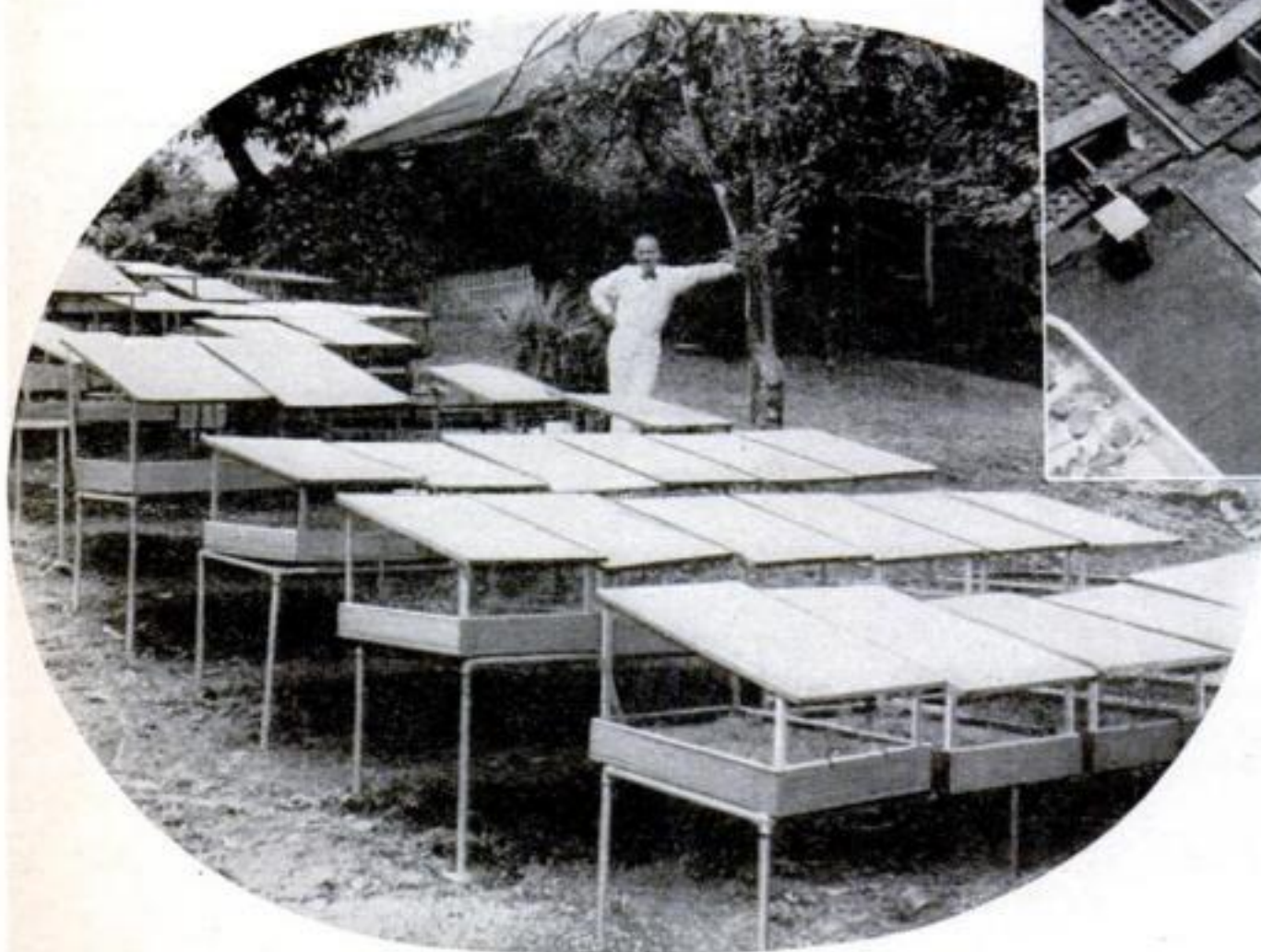


British Bobbies Wired for Lights

WHAT the well-dressed British policeman is wearing at night in war-darkened cities is shown in the photograph above. In addition to a white coat, the officer has a sign reading "Police" mounted on his helmet, and carries red and green lamps. Batteries light both sign and lamps.

Luck Farm Produces Four-Leaf Clovers

FINDING a four-leaf clover is no trick at all at an unusual farm run by C. T. Daniels, Panama Canal Zone horticulturist. For fifteen years, Daniels has been developing pure four-leaf-clover seed. Now, he grows the good-luck plants on a production basis, shipping them in pressed form to all parts of the world. The beds below hold over 1,000,000 plants.



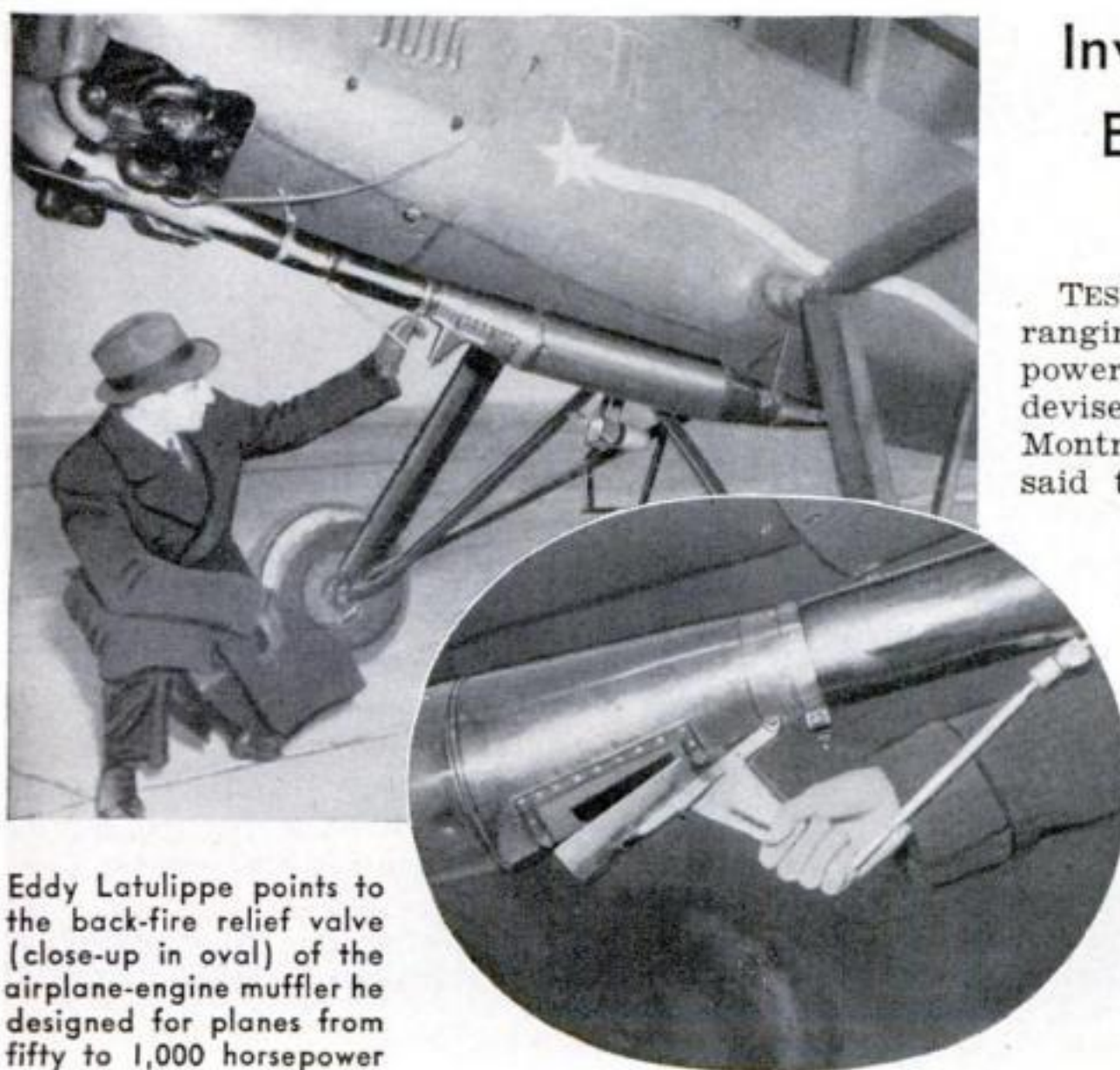
Good luck for sale: Four-leaf clovers being pressed for shipment. The beds at the left, on C. T. Daniels' odd farm in the Canal Zone, hold more than 1,000,000 of the lucky plants



This Time It's Not Done with Mirrors!

How many people do you see in the picture above? You're right if you say four. By using a mirror frame, a black background, and two sets of identical twins, a Philadelphia, Pa., cameraman achieved the

striking result shown here. The position of the lights and of the four subjects, Jo and Jeanne Reading and John and Frank Delmar, were carefully worked out before the shutter was snapped.



Eddy Latulippe points to the back-fire relief valve (close-up in oval) of the airplane-engine muffler he designed for planes from fifty to 1,000 horsepower

Inventor Perfects Engine Muffler for Planes

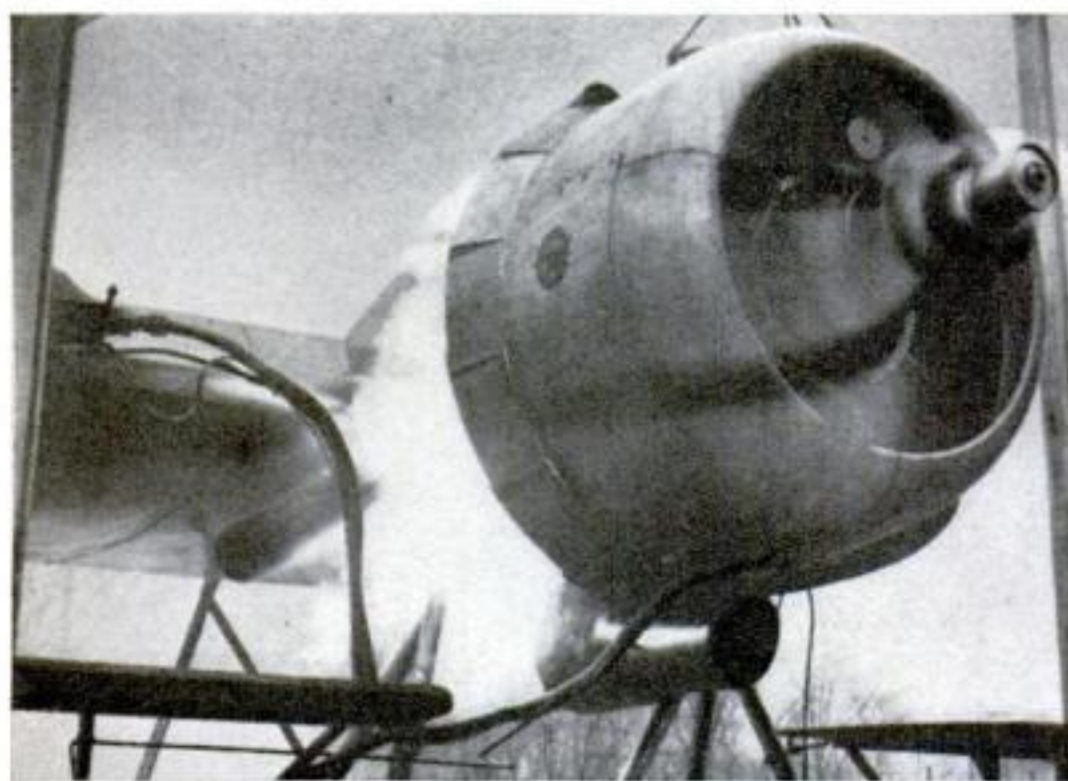
TESTED on airplane engines ranging from fifty to 1,000 horsepower, a new exhaust silencer, devised by Eddy Latulippe, a Montreal, Canada, inventor, is said to have demonstrated its ability to cut out seventy percent of the exhaust noise without causing any excess back pressure or cutting down the number of revolutions of the power plant. The weight of the entire installation, depending upon the size of the engine, ranges from eight to twenty-three pounds. A "back-lash trapdoor" opens automatically in case of a back fire.

Odd Shout-O-Phone Spans Border



The inventor equipped for an over-the-border chat

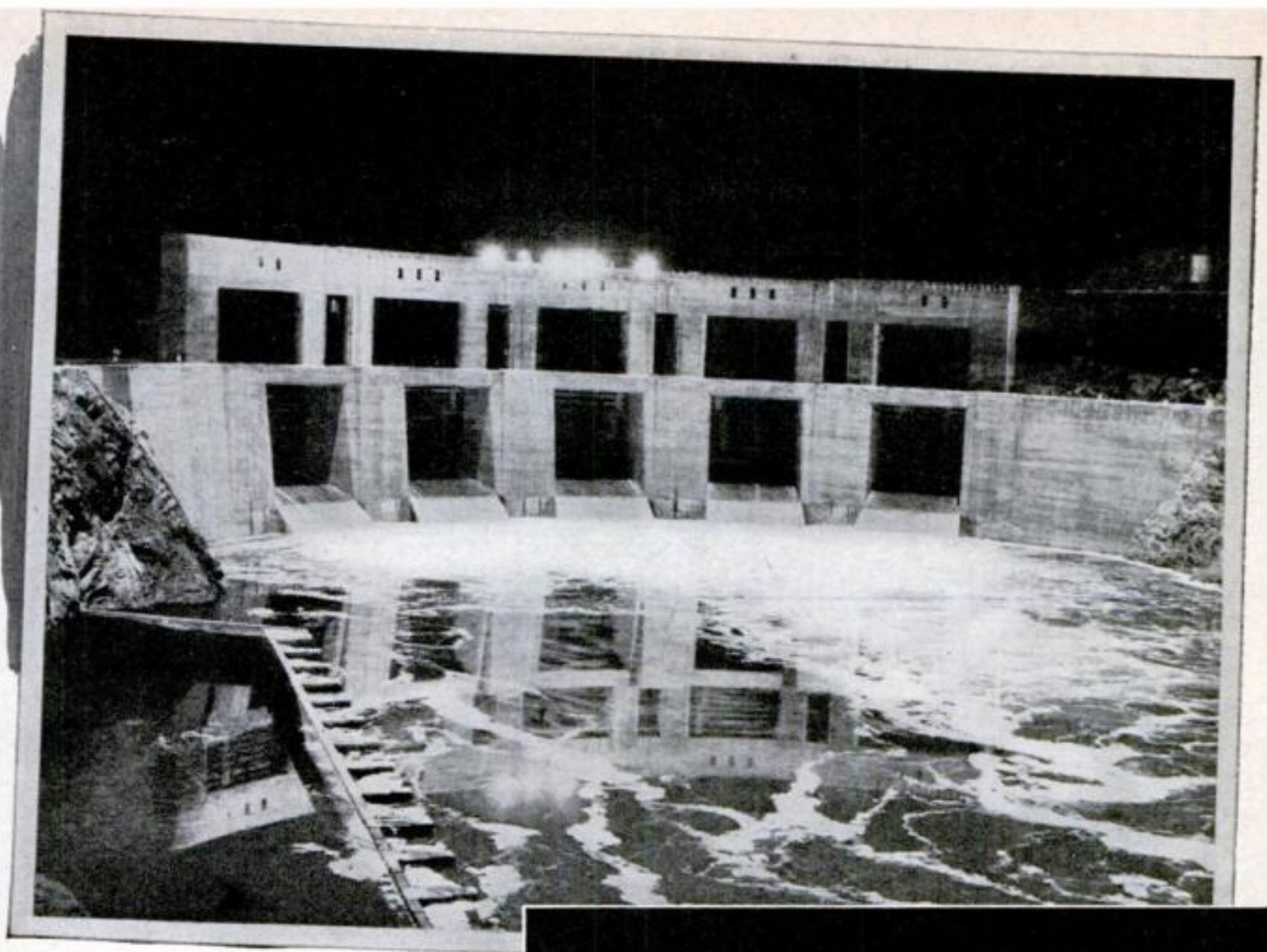
FRIENDS and relatives on opposite sides of the French-Swiss border must exchange greetings across a forbidden zone seventy feet wide, but that doesn't matter to the well-equipped conversation-
alist shown at the left. He talks through a megaphone, and listens with ear trumpets like airplane detectors, while his binoculars complete the illusion of nearness.



After fire in the motor-test set-up at top burned for twenty seconds, gas shot from the built-in ring (as below) put it out

Gas-Spraying Ring Smothers Flames in Plane Motor

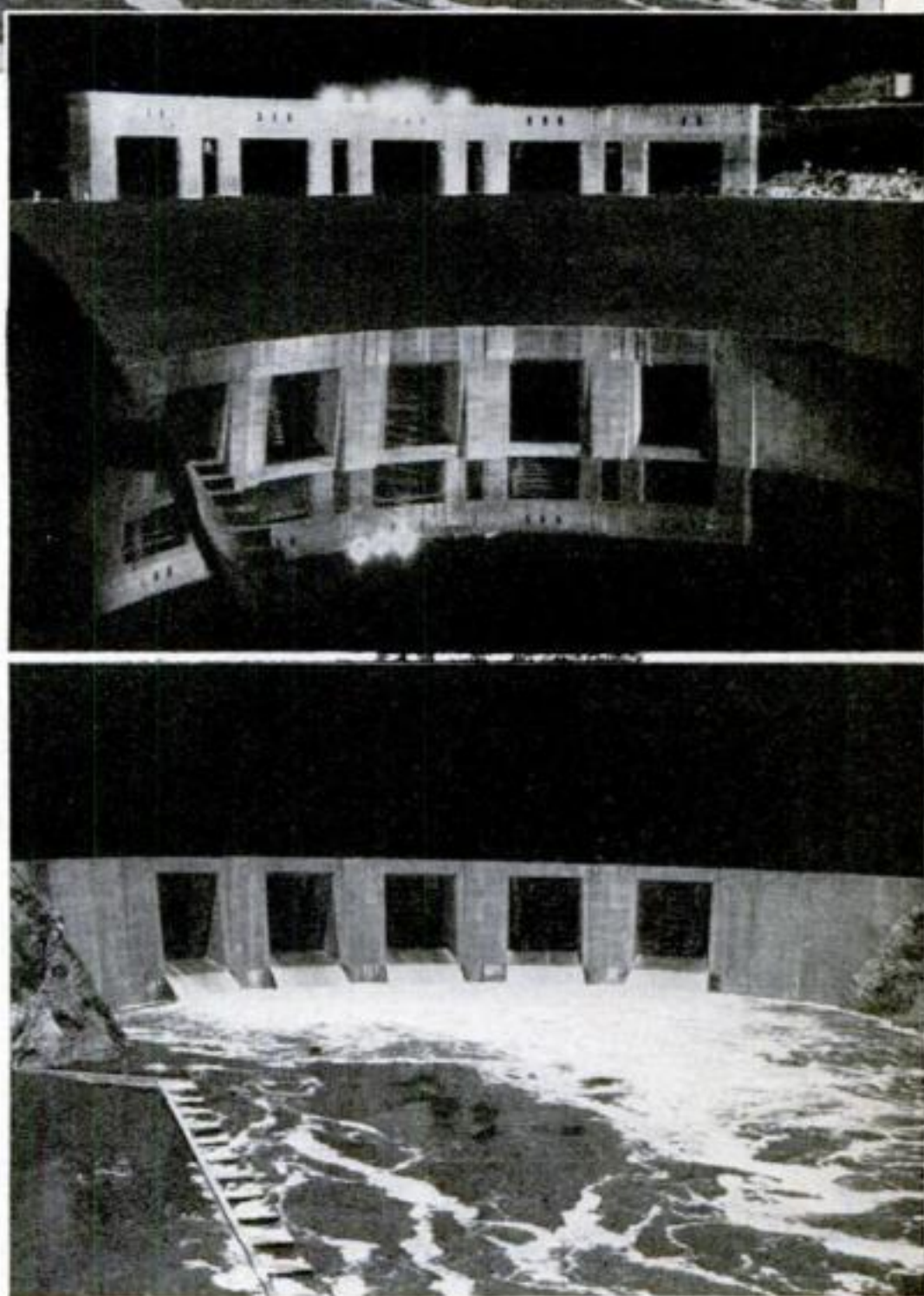
ONE of the gravest of air perils—fire starting in a plane's motor—may be eliminated with an extinguisher under development by the Civil Aeronautics Authority. An automatic detector in each engine housing warns a pilot of the outbreak of fire by flashing a red lamp on the instrument panel. Simply by turning a small valve, the pilot releases a stream of carbon dioxide gas, carried in small steel bottles under high pressure. Piped to the engine, the fire-smothering gas escapes from tiny holes in a ring-shape tube encircling the cylinders. After an oil fire had been allowed to burn for twenty seconds, in the test set-up illustrated by the top view, the gas extinguisher put out the flames in five seconds. The lower picture shows the circular nozzle removed from the engine and set in action. What look like spokes of a wheel are actually jets of escaping carbon dioxide, converging to form dense white clouds over the theoretical danger spot.

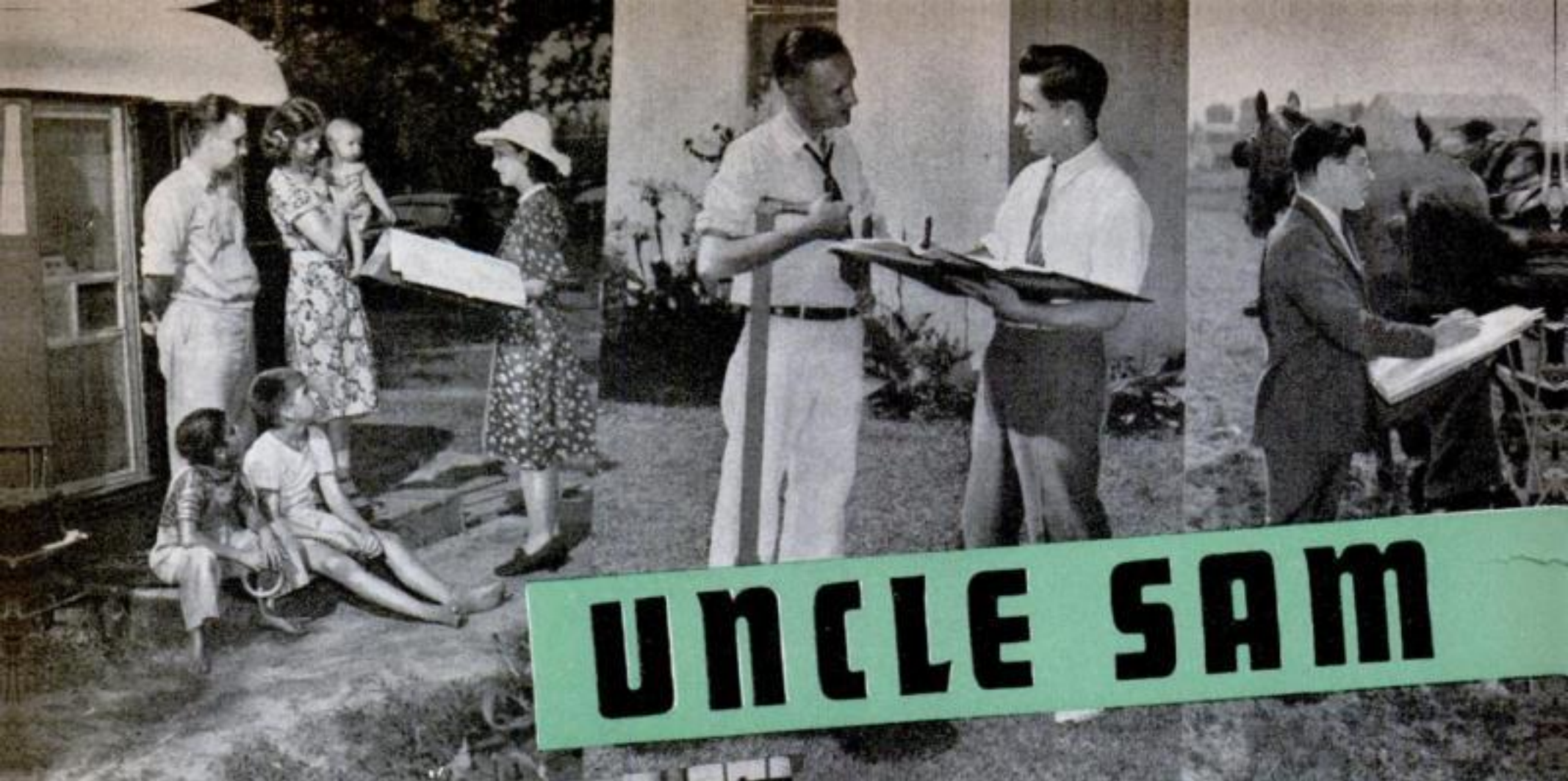


The remarkable photograph above was made by combining the two shown at the right

Combination Day and Night Photograph

BY COMBINING a photograph taken in daylight with a time exposure made at night, a southern California cameraman recently produced the unusual photograph shown above. What he wanted to picture was a night view showing water flowing over the Parker Dam, on the lower Colorado River. But to take a night view of such a large area and to stop the action of the water would have required extensive floodlighting, possible only at prohibitive expense. Employing an etching process in his developing laboratory, the photographer combined the two views at the right to produce the one reproduced above.



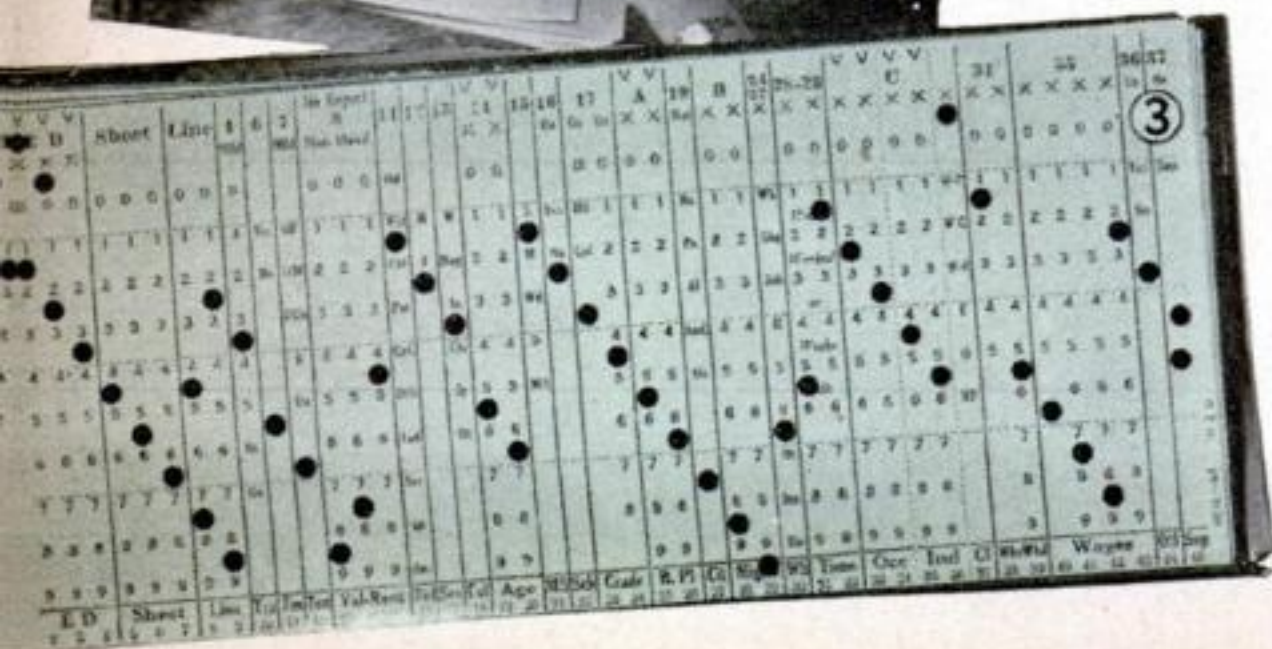


UNCLE SAM

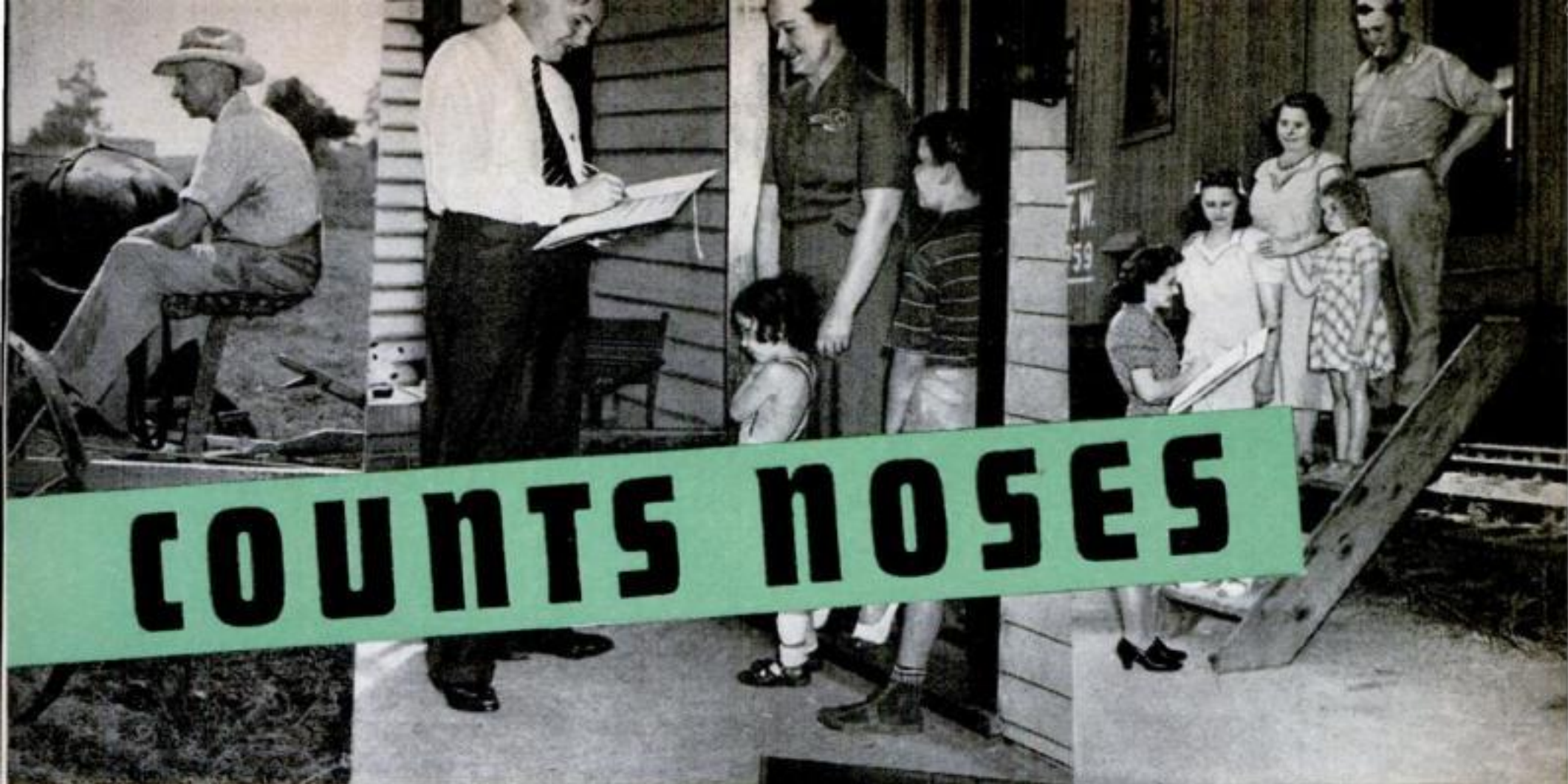
HOW AMAZING MACHINES

LAST month the census taker came to call. He unfolded a big white sheet of paper and began firing questions. Name? Age? Birthplace? And so on until he knew all the answers, and departed with his pencil-checked list. All over the country, 120,000 fact finders were doing the same. So far as foresight in planning could provide, they overlooked no dwelling's occupants; they even visited auto trailers, marking them with stickers to avoid recounting!

What has happened to your census blank? The scene shifts to the spacious building of the Census Bureau at Washington, D. C., where registered mail has brought neatly packed wooden boxes containing the facts about 132,000,000 Americans. Now begins the stupendous task of refining this mountain of data, and totting up the figures in some forty closely printed volumes of significant findings. Clerks doing it by hand would scarcely finish the job by the time for a new census. But ultramodern ma-



1. Employees of the U.S. Census Bureau operating punching machines which translate facts gathered by census enumerators, such as those above, into holes punched in cards. 2. Close-up of punching machine. It will turn out 2,500 cards a day, each one containing the essential facts about a person. 3. A specimen perforated card



COUNTS NOSES

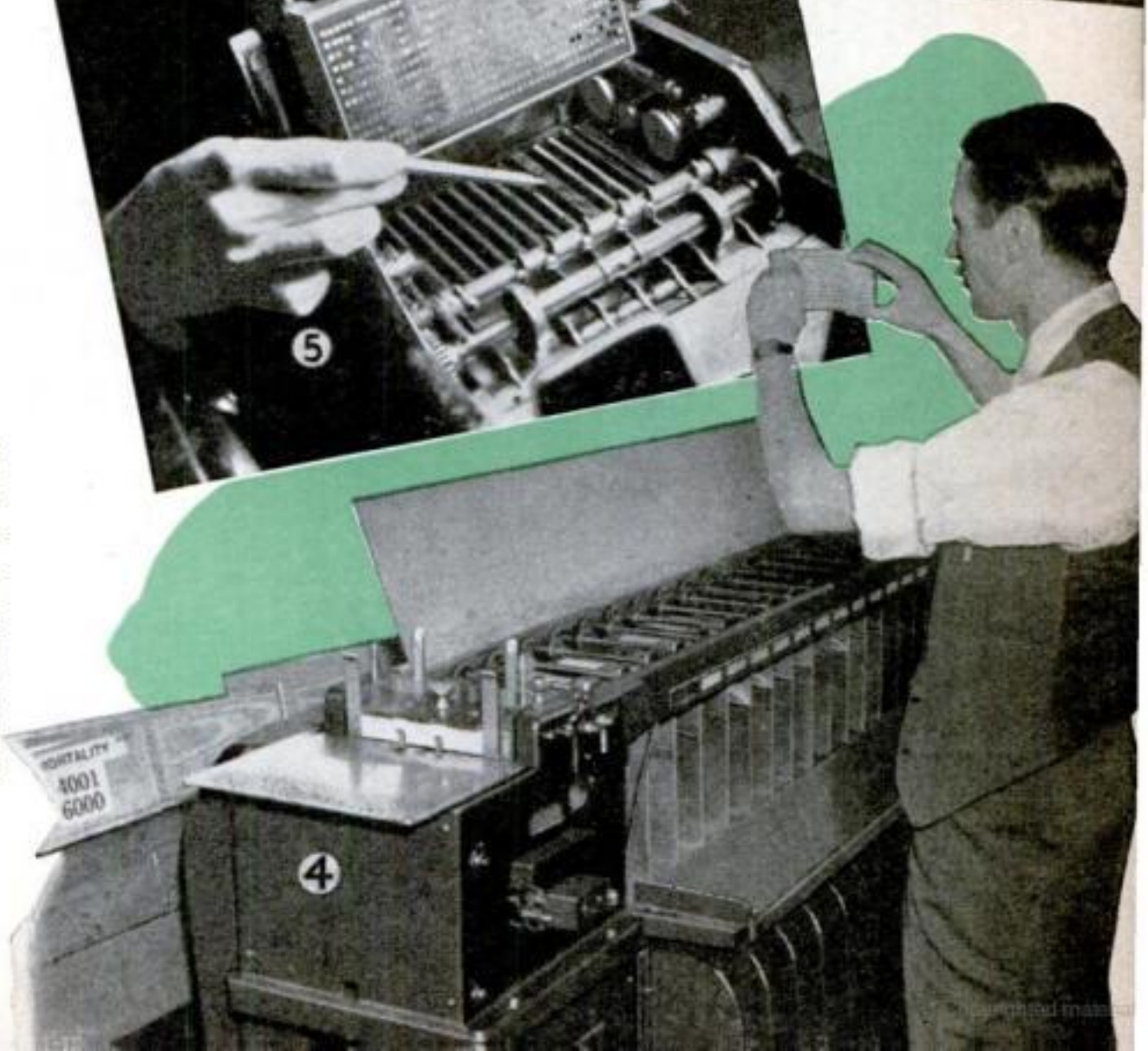
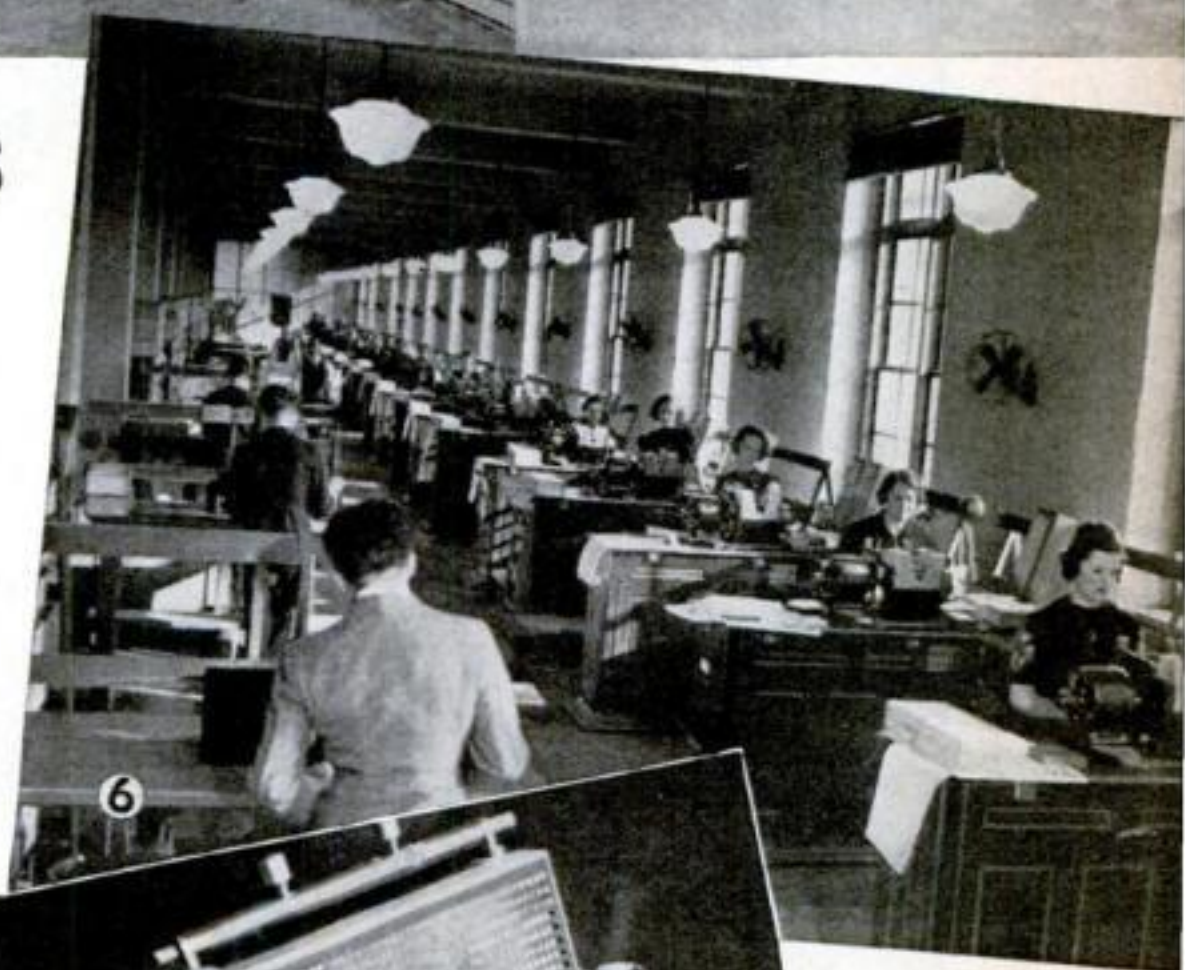
HELP TAKE THE CENSUS

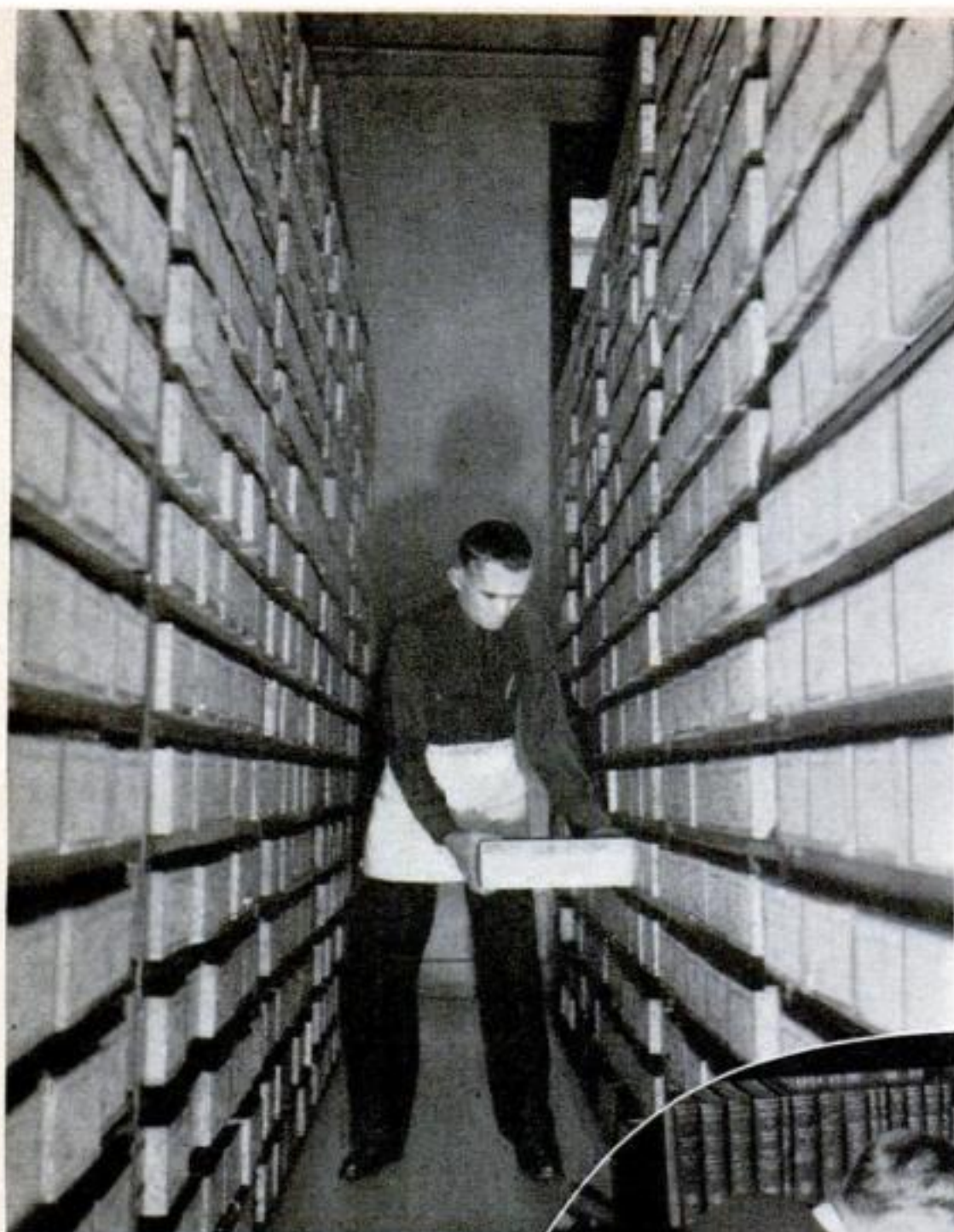
chinery—applying the punched-card system devised by Herman Hollerith, a former census man—has streamlined the undertaking.

Look over the shoulder of this girl at a punching machine containing a blank card three and a half by seven and three eighths inches. Before her rests an edited, coded, census questionnaire—possibly your very own. Deftly her fingers play upon thirteen keys. The card emerges punched with holes which show, by their position alone, everything that Uncle Sam wants to know about you.

Through a marvel of automations, the electric sorting machine, rush the punched cards at 400 a minute. Suppose they are being sorted for age. As they fly along a conveyor, brushes of fine wire complete an electrical circuit through the punched hole in the "age" column. Cams shunt

4. One of the sorting machines. Cards being classified drop off a conveyor into proper compartments. 5. Nerve center of a tabulator; pencil points to a brush making contact through a hole to operate a counter. 6. A battery of tabulators; each can handle 400 cards a minute, compiling many items of information from each and adding up totals for statistical use



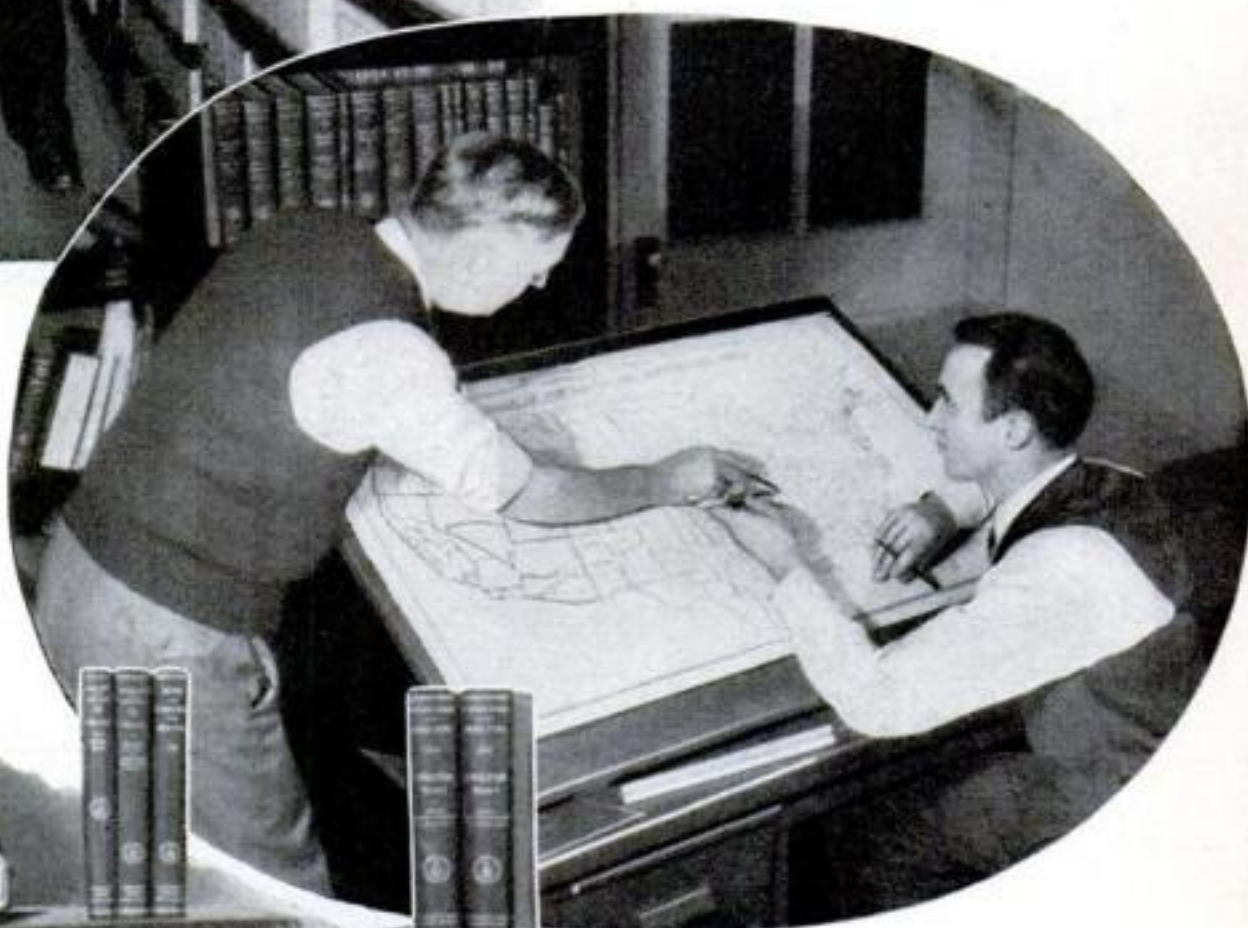


Millions of punch cards are kept in wooden boxes on these shelves at the Census Bureau headquarters

the cards into different conveyor tracks—leading to the correct age group, say, "35-40."

Keeping up the 400-card-a-minute pace, an automatic tabulator subdivides and records the facts about each age group—how many are married, what their occupations are, and forty or fifty other facts about them. Totals registered on counters can be printed at any time. Only lightning-fast machines would serve, for the cards will be re-sorted and recounted many times.

Every ten years, under the Constitution, the census must be taken. The first census, a pen-and-ink tabulation made in 1790, merely counted the number of people—a few less than 4,000,000. Since then, supplementary queries have given the census constantly growing value for a large number of governmental and private agencies.



Geographers mapping an enumeration district. There are some 143,000 of these areas, and careful planning guards against overlapping



The girl at the left holds a book which contains the report of the 1790 census. Data accumulated by the 1930 count fills thirty-two volumes like those pictured

Workers constructing miniature buildings for the vast scale model of the city of Los Angeles, Calif.



General view of the model. Built to the scale of one inch to fifty feet, it gives minute details

Mammoth Model Shows All of Los Angeles

CONSTRUCTED to the scale of one inch to fifty feet, a model of the city of Los Angeles, Calif., is being built under the supervision of the city engineering department. Every street and building in America's fifth largest

city eventually will appear on the gigantic model. Although only partially completed, the project already is said to have saved thousands of dollars in helping engineers plan new parkways and rapid-transit lines.

Sound Probe Aids Snow Rescues

TO ASSIST in finding persons buried in deep snow, a Swiss physician has devised a "talking probe." It consists of a long probing stick in which are located a listening tube and a delicate microphone. Touching a solid object in the snow, the stick gives off a distinctive sound.



A microphone in the tube reveals the nature of objects in the snow



Gloves Have Room for Long Nails

FINGER-NAIL compartments, designed to accommodate long nails, are part of a new-type women's glove. The top piece of leather on each finger extends beyond the end of the finger proper to provide a pocket for the nail.

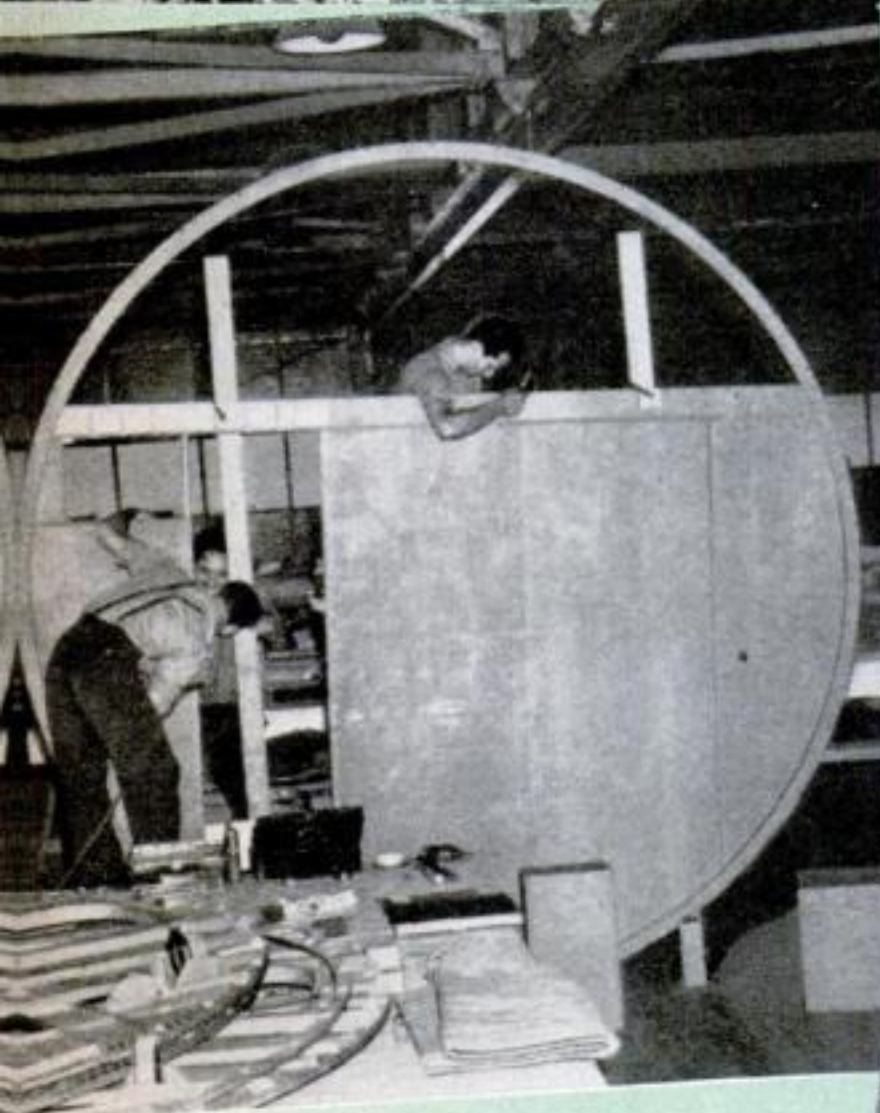
Flying Four Miles

STRATOSPHERE LINERS BLAZE NEW

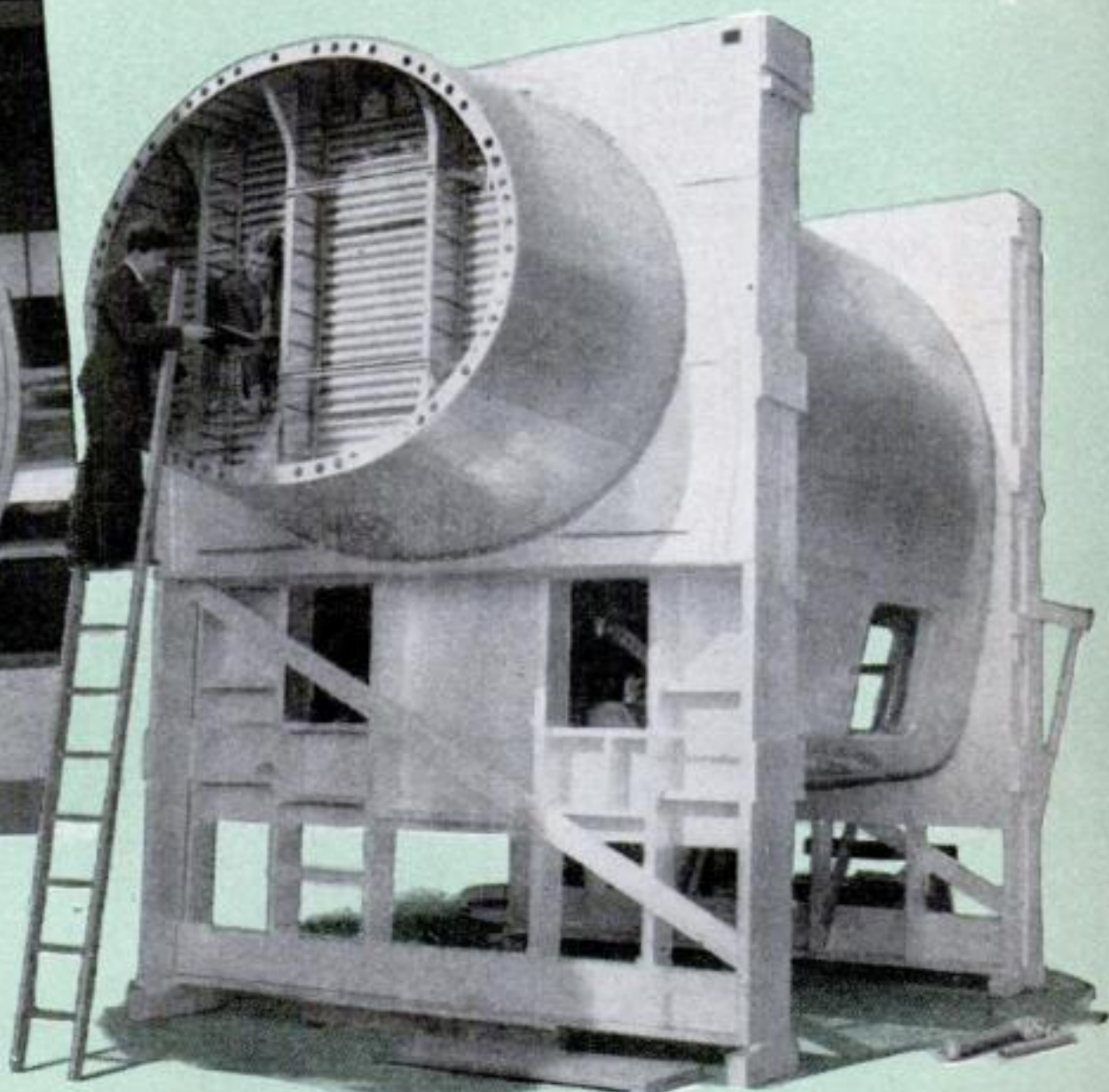


BOASTING sealed cabins to withstand the near vacuum of substratosphere air, giant streamline passenger planes that cruise at four miles a minute at 20,000-foot altitudes are about to join the nation's fleet of commercial air transports. Bringing comfort never before experienced by air travelers, these mighty planes are designed to carry from thirty to nearly fifty passengers at a time in dusk-to-dawn flights across the continent, well above the atmospheric winds and storms of the lower levels.

Soon to start operations on the substratosphere route, a fleet of Boeing Stratoliners is nearing

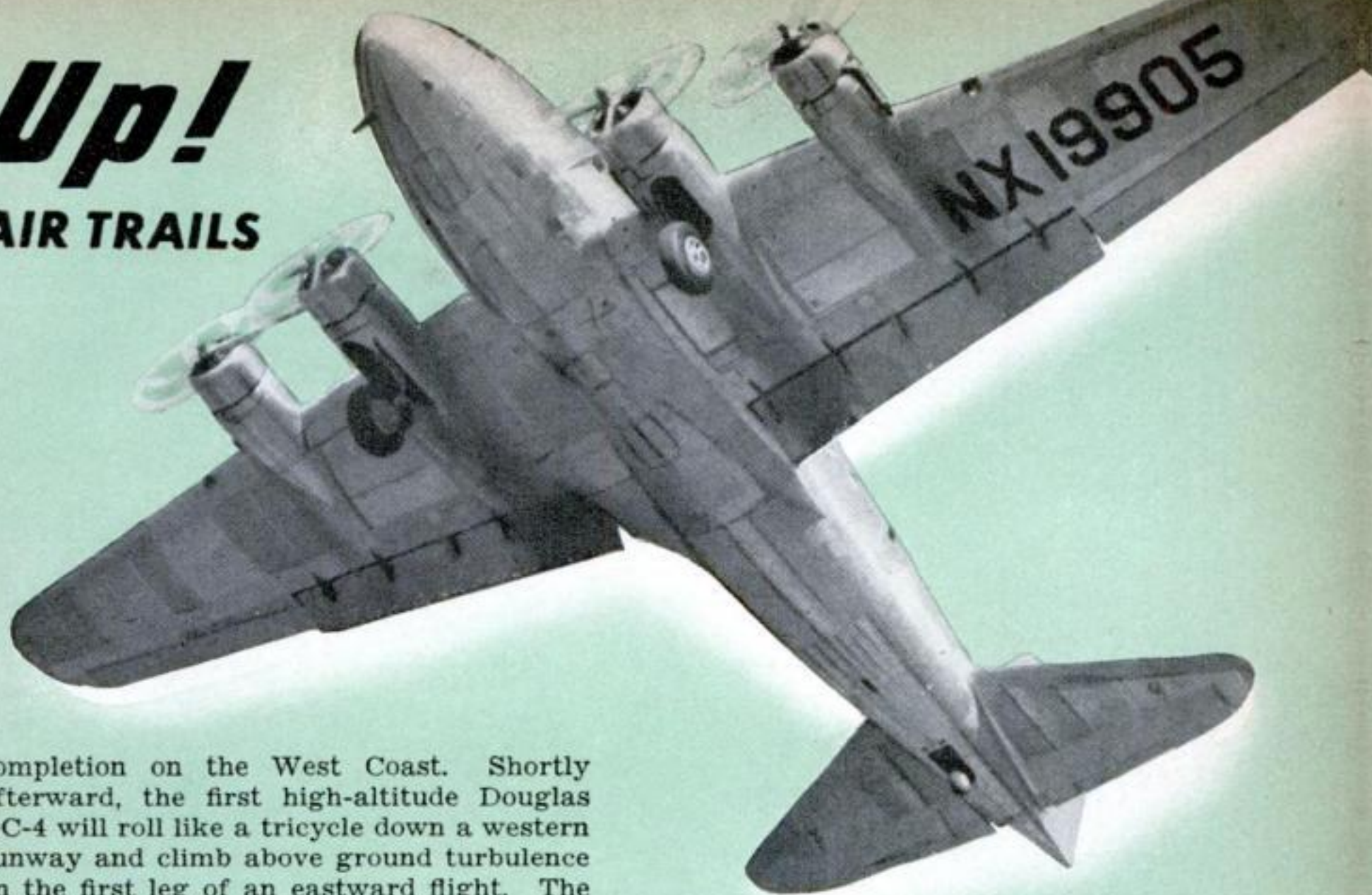


Building the new substratosphere planes. Engineers above work on a bulkhead, and at the right on an air-tight section of a fuselage



Up!

AIR TRAILS



completion on the West Coast. Shortly afterward, the first high-altitude Douglas DC-4 will roll like a tricycle down a western runway and climb above ground turbulence on the first leg of an eastward flight. The race of the giants will be on!

In these luxury liners there will be no physical sensation of altitude, no gasping for oxygen in the rarefied atmosphere, no shivering in cold drafts. You will ride in

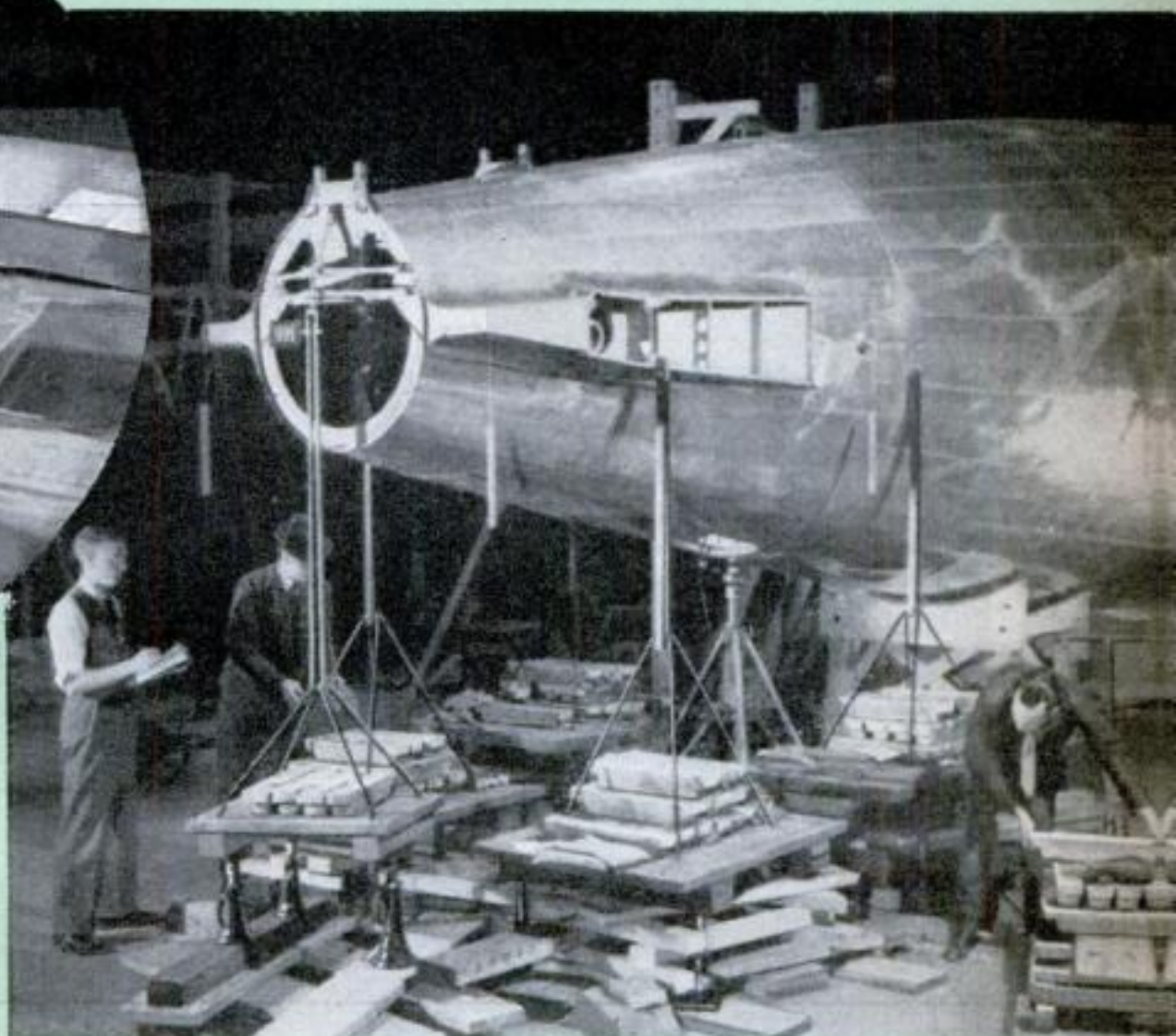
cabins sealed tight against the air and capable of withstanding internal pressure of six pounds to the square inch. And although you will ride at an altitude of 18,000 to 20,000 feet, the "altitude" in the cabin will be no more than 10,000.

For nearly two years, engineers have

By ROBERT E. MARTIN



Four-engine Boeing Stratoliner, at top, coming in after a test. Blowers forced air into its sealed-up cabin while it climbed four miles, maintaining comfortable air pressure for its occupants. Circle, testing seams with soapsuds for leaks. Weights hung from tail show that cabins are even stronger under pressure

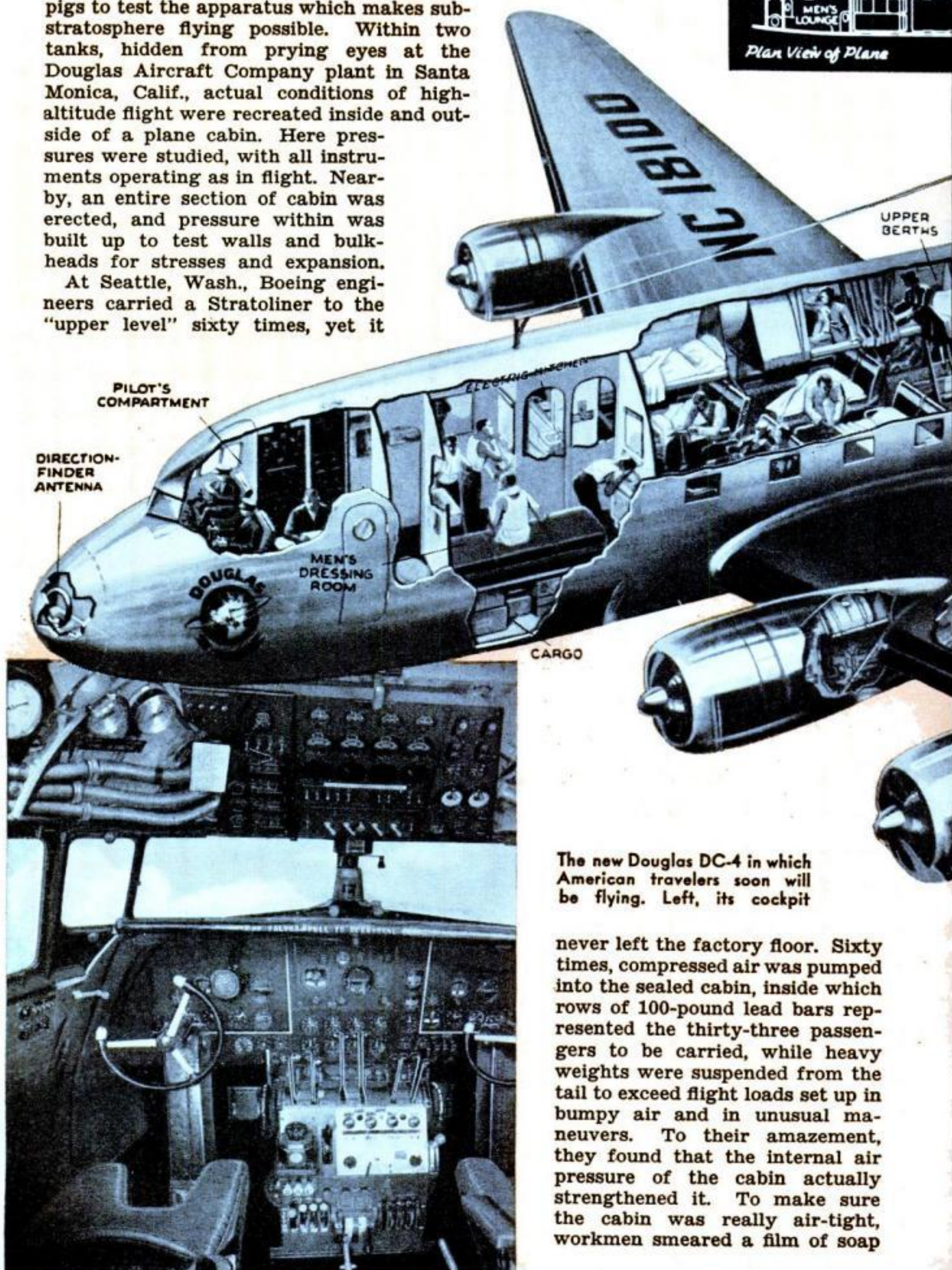


been experimenting on the ground and in the air, offering themselves as human guinea pigs to test the apparatus which makes sub-stratosphere flying possible. Within two tanks, hidden from prying eyes at the Douglas Aircraft Company plant in Santa Monica, Calif., actual conditions of high-altitude flight were recreated inside and outside of a plane cabin. Here pressures were studied, with all instruments operating as in flight. Nearby, an entire section of cabin was erected, and pressure within was built up to test walls and bulk-heads for stresses and expansion.

At Seattle, Wash., Boeing engineers carried a Stratoliner to the "upper level" sixty times, yet it

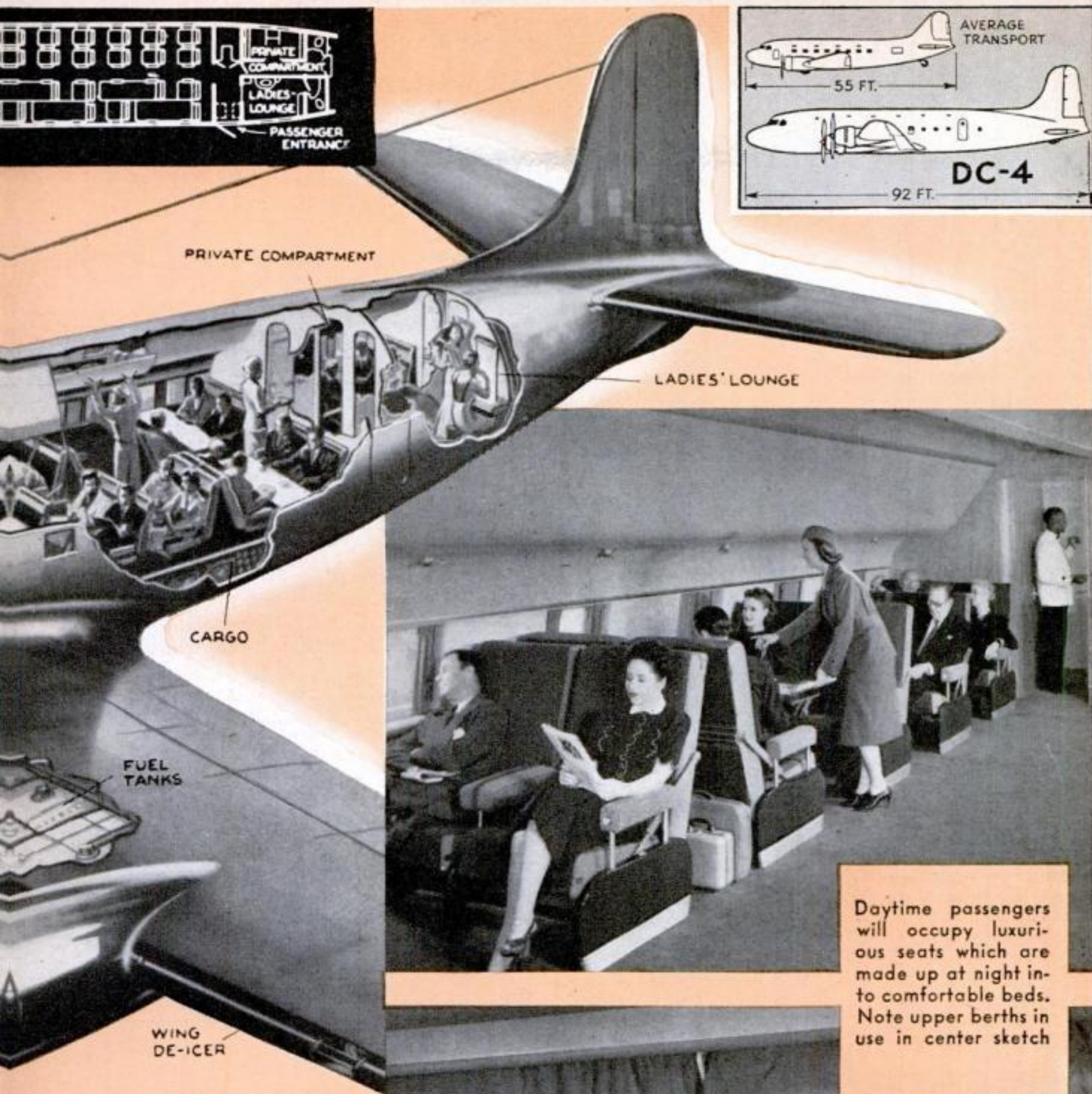
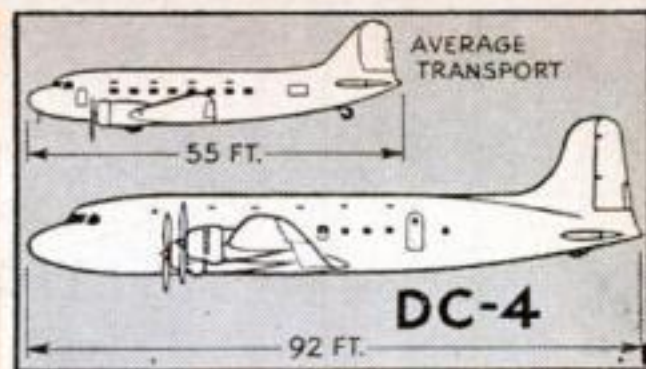
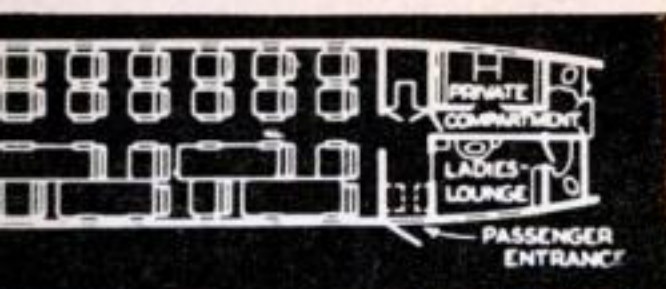


Plan View of Plane

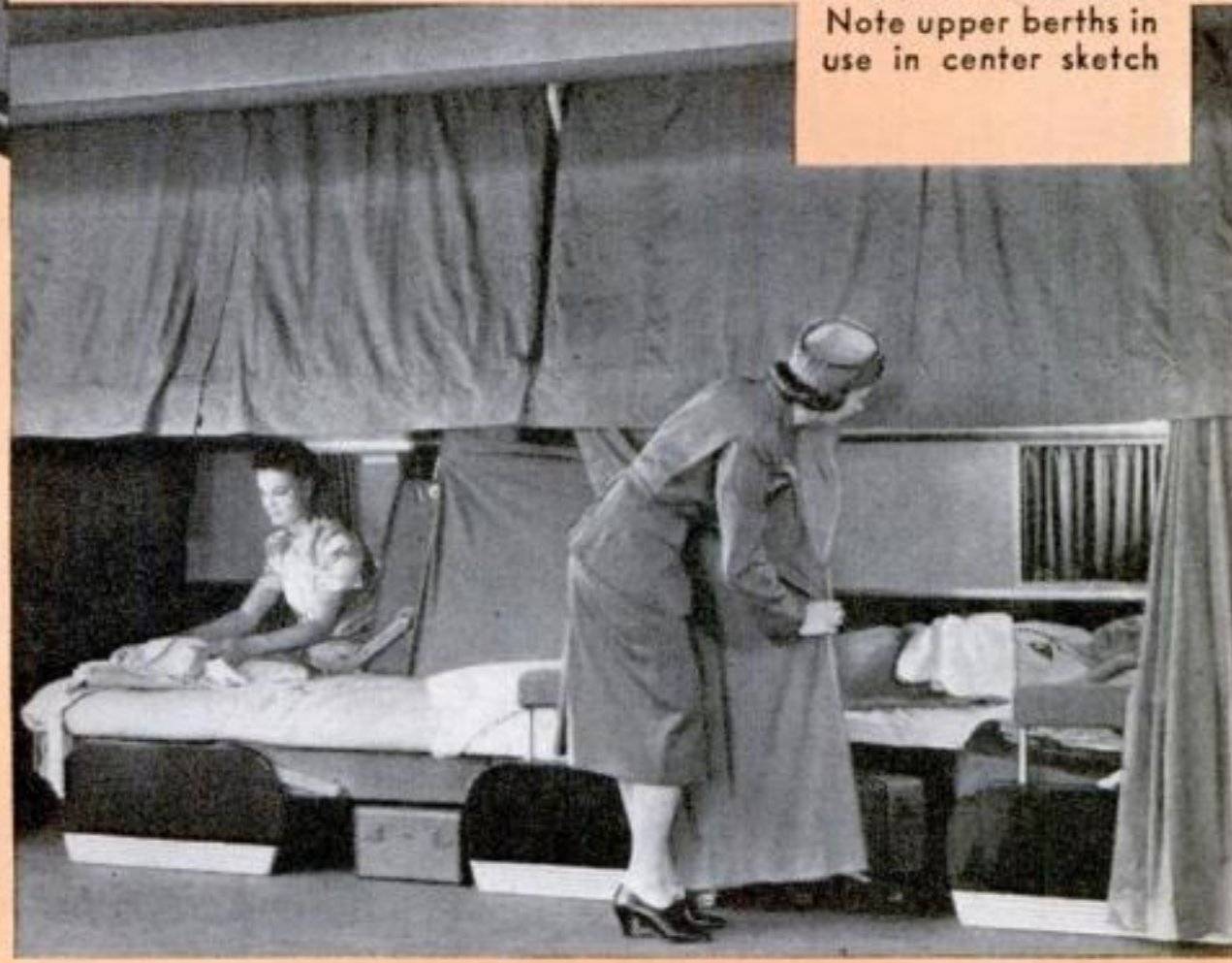


The new Douglas DC-4 in which American travelers soon will be flying. Left, its cockpit

never left the factory floor. Sixty times, compressed air was pumped into the sealed cabin, inside which rows of 100-pound lead bars represented the thirty-three passengers to be carried, while heavy weights were suspended from the tail to exceed flight loads set up in bumpy air and in unusual maneuvers. To their amazement, they found that the internal air pressure of the cabin actually strengthened it. To make sure the cabin was really air-tight, workmen smeared a film of soap



Daytime passengers will occupy luxurious seats which are made up at night into comfortable beds. Note upper berths in use in center sketch



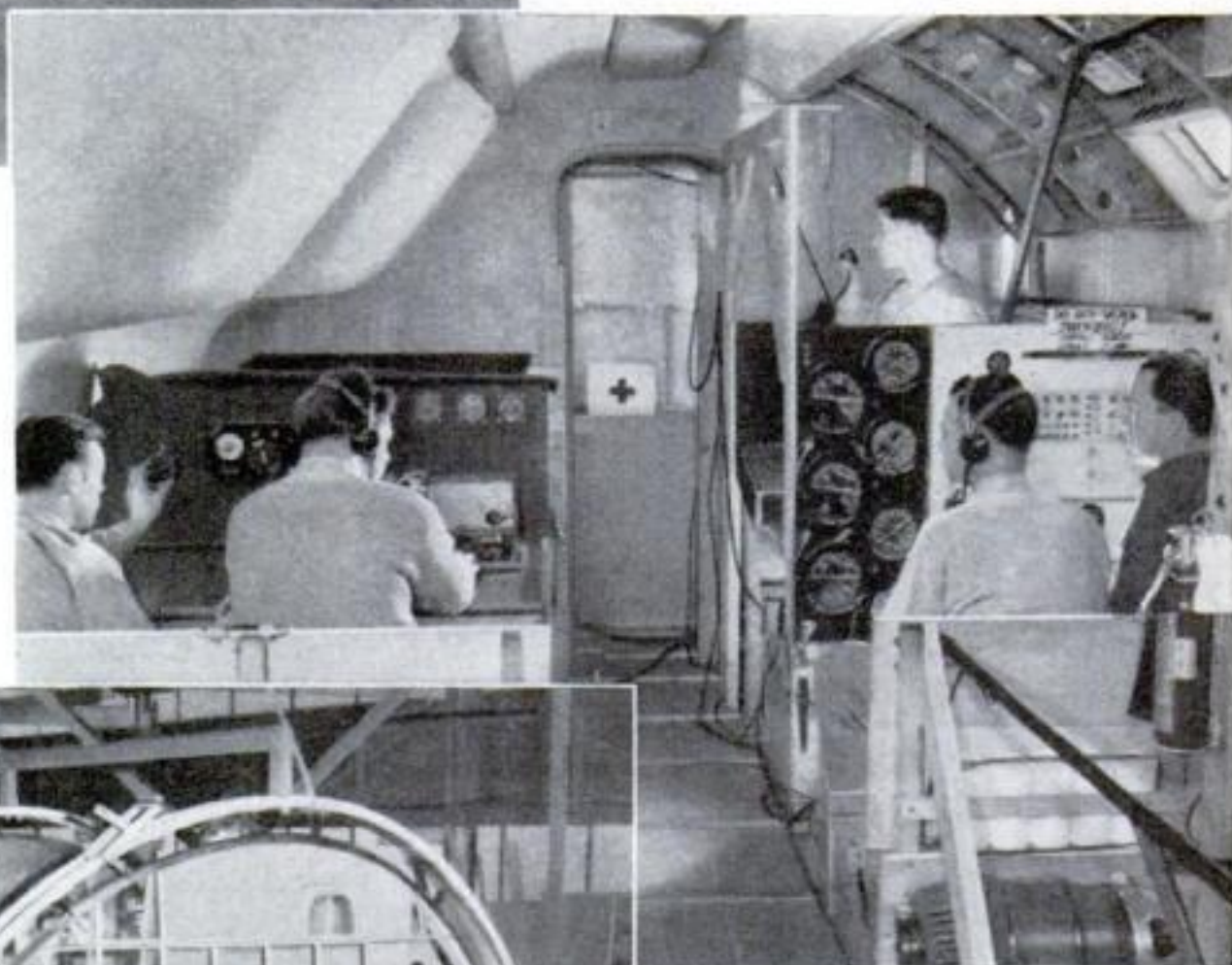
over the metal seams and rivets; then watched for telltale bubbles.

In flight, a pair of superchargers or "blowers," driven by two of the engines, force air taken in at the leading edge of the wing into the cabin. Heaters maintain the air temperature at seventy degrees.

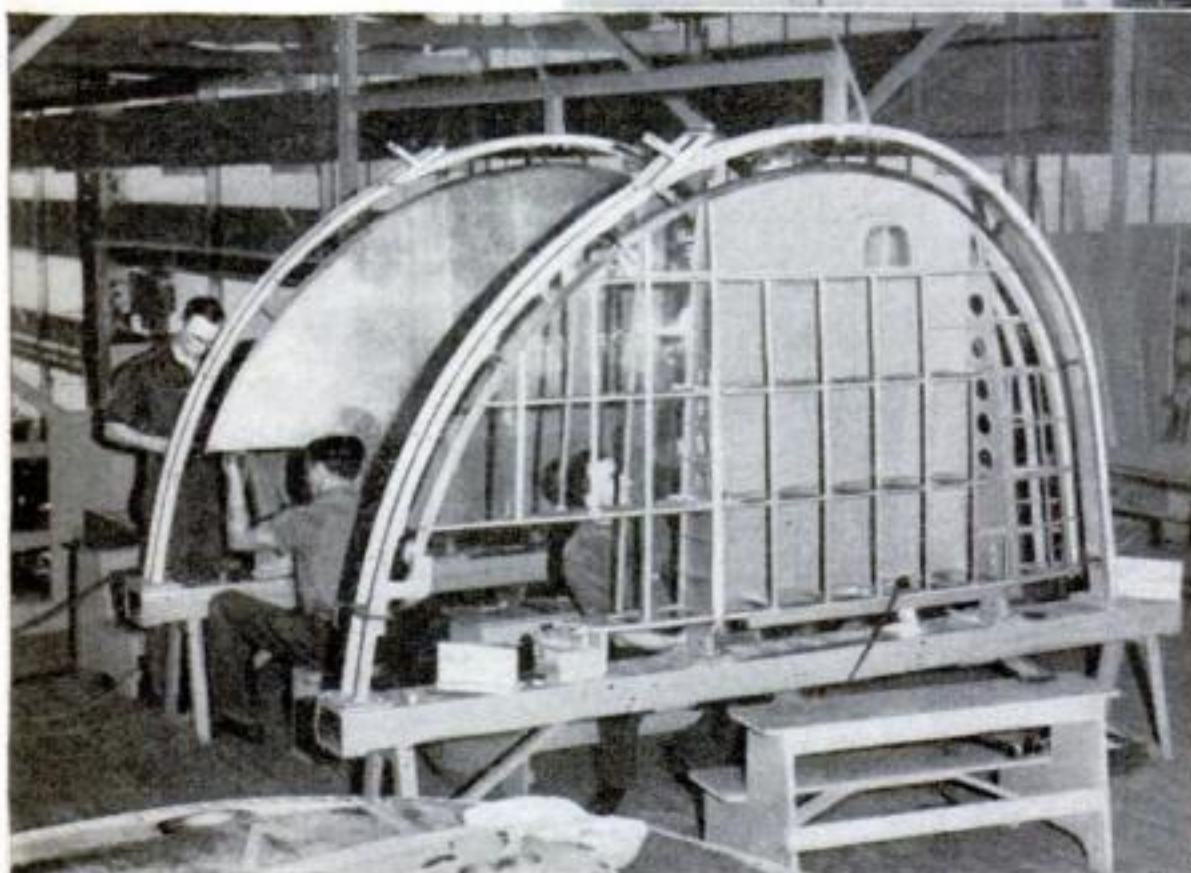
If you take an imag-



One of the main wheels of the DC-4 is taller than a girl. Its tire weighs 357 pounds, holding air weighing another twenty pounds. It is retracted in flight



In a Stratoliner cabin during tests. Engineers at the switchboards checked every detail of the ship's performance on trips totaling more than 125,000 miles



The wing-tip panels alone, seen at left being assembled, have a total surface area greater than the entire wing area of many a small-size, racing-type plane

inary trip in one of these luxurious big ships, for instance the Douglas, you will understand quickly how this intricate system operates. You enter the cabin and sink into a deeply upholstered seat. Shortly the door is sealed shut, and the pilot guns the four powerful motors.

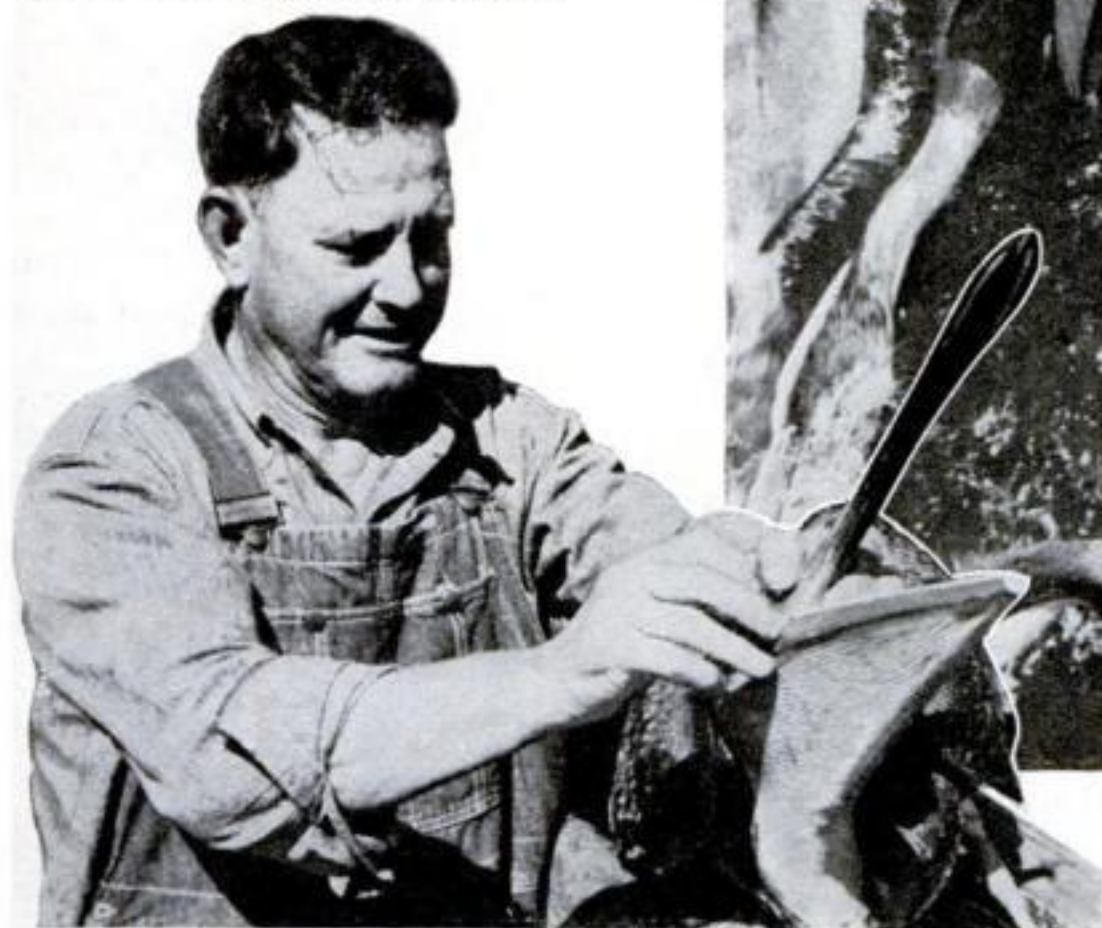
The ship takes off at full throttle—4,800 horsepower. As it clears the airport, your pilot switches on the cabin superchargers. You are not conscious of changing air, but you note that the thermometer registers seventy.

Now the pilot throttles down a bit, climbing 1,000 feet a minute with 3,600 horsepower pouring into the props. You hear little of their noise, because an electrical synchronizer keeps all four constant-speed propellers turning at the same speed.

Climbing this fast is something new in air-line flying, yet your ears don't "pop" as you go up. Minutes pass; *(Continued on page 226)*

Pelican Surgery Won Him a Medal

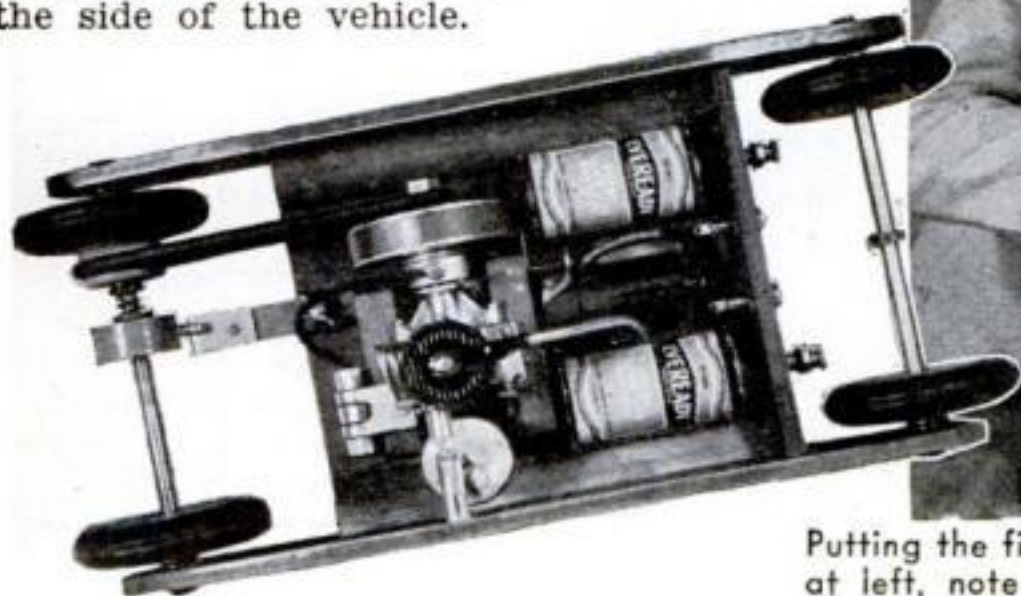
SURGICAL operations on pelicans have won a humane-society medal for Gus Baier, owner of a waterfront fish market in Long Beach Calif. He captures birds that have been injured by fish-hooks or lines. After sewing up a ripped pouch, or amputating a leg, he releases the patient.



Some of Gus Baier's patients. At the left, the pelicans' good Samaritan is extracting a fishhook from a bill

Racing-Buckboard Model Built from Kit

A TRIM, racing-buckboard type of model automobile is now available in kit form for model enthusiasts. Plywood parts for the chassis are supplied cut to exact shape, with patterns for all parts showing the location of holes for assembly screws, axle bearings, battery fixtures, wiring, and other elements. The front axle may be adjusted for steering, or the usual radius cord (P.S.M., Feb. '40, p. 61) can be attached to the side of the vehicle.



Putting the finishing touches on the model. In the top view at left, note the automatic starting clutch on rear axle



The spotlight-magnifier unit as used for examining the teeth

Strap-On Headgear Is Dentist's Aid

CLOSE examination by a dentist of a patient's teeth is made easier by a spotlight and magnifying outfit recently introduced. Mounted on an adjustable frame, a compact spotlight is attached to a flexible band that fits around the head of the examining dentist. A magnifying lens is fastened to an extension arm jutting out from the bridge of the dentist's spectacles. With this equipment, the examiner is given an illuminated and magnified view of the interior of a patient's mouth.

Air-Conditioned Kennel

BEING "in the dog house" should be a pleasure if the canine home is anything like the one pictured in the photograph below. Exhibited at a recent exposition of heating and ventilating products, the dog house is modeled after a modern dwelling and is completely air-conditioned. Large enough to accommodate several over-

size hounds, or even their owners, the mastiff mansion is the latest wrinkle in pooch-pampering.



A "dog's life" is a happy one in this air-conditioned house



Clock Tells Time from Any Angle

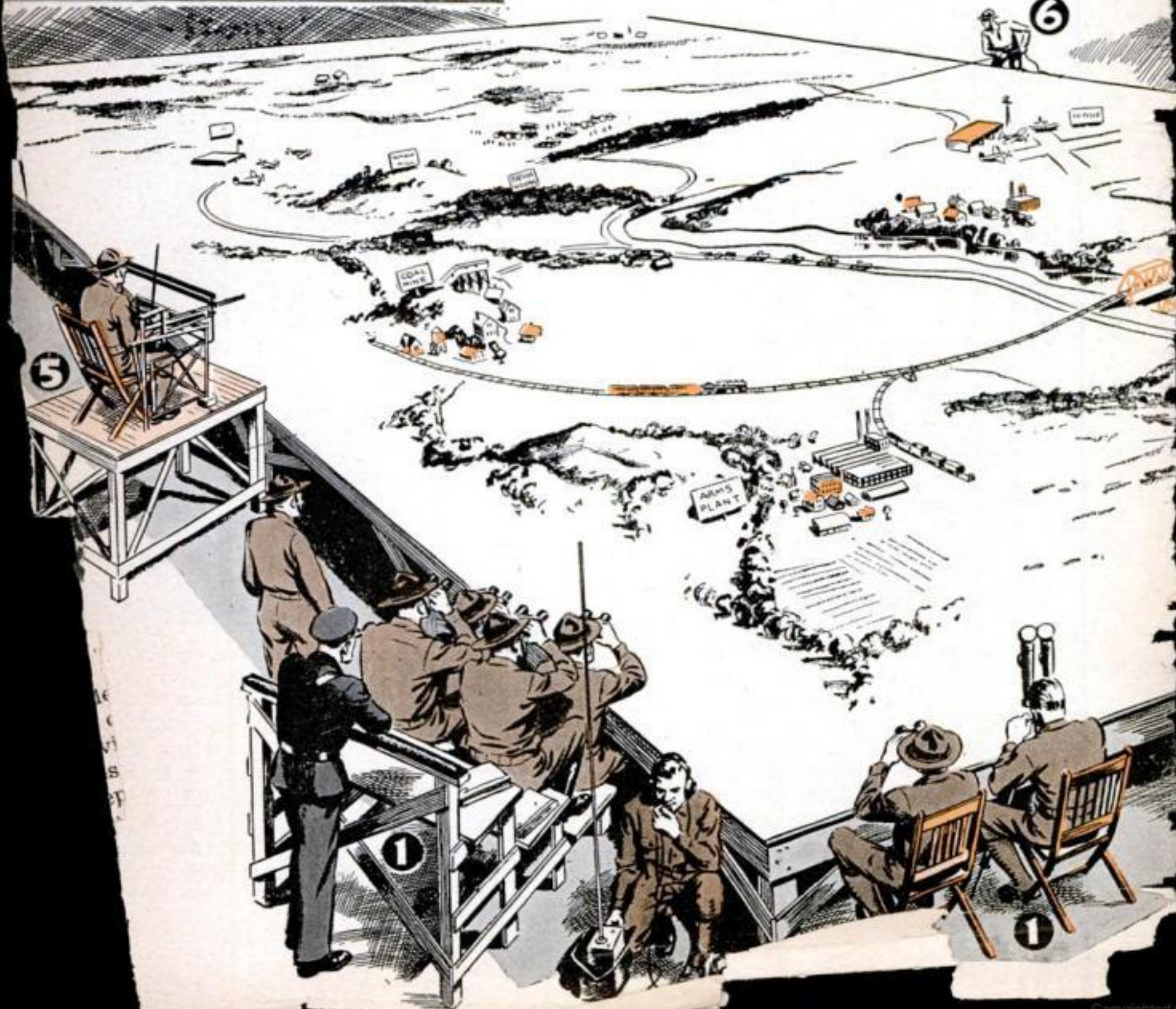
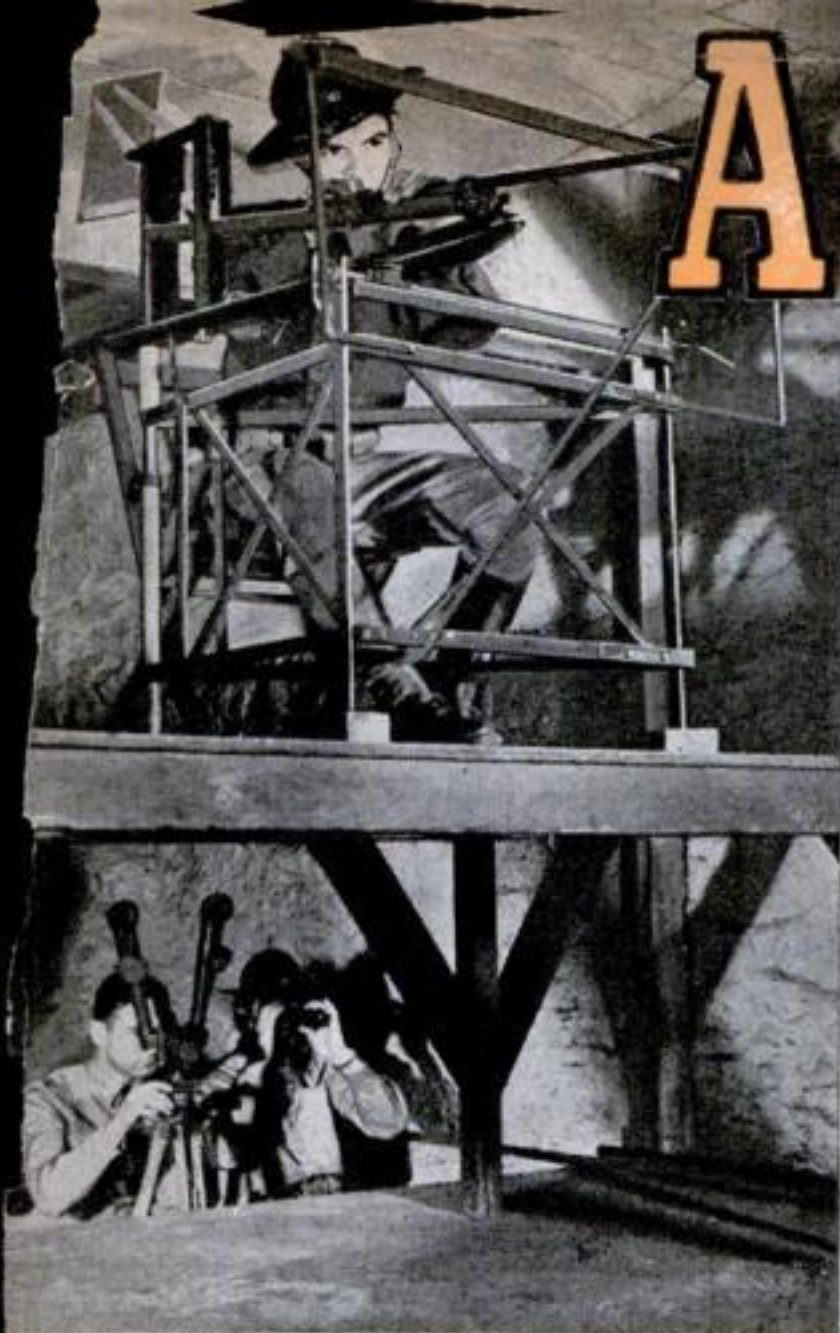
FITTED with specially designed numerals, a novel clock makes it easy to tell time no matter at what angle the timepiece is viewed. Hour numbers are lettered on both sides of projections from the clock face, which are shaped like wedges of cake. Thus the numerals can be seen from an angle far to the right or left of a position directly in front of the clock face.

Army Gunners

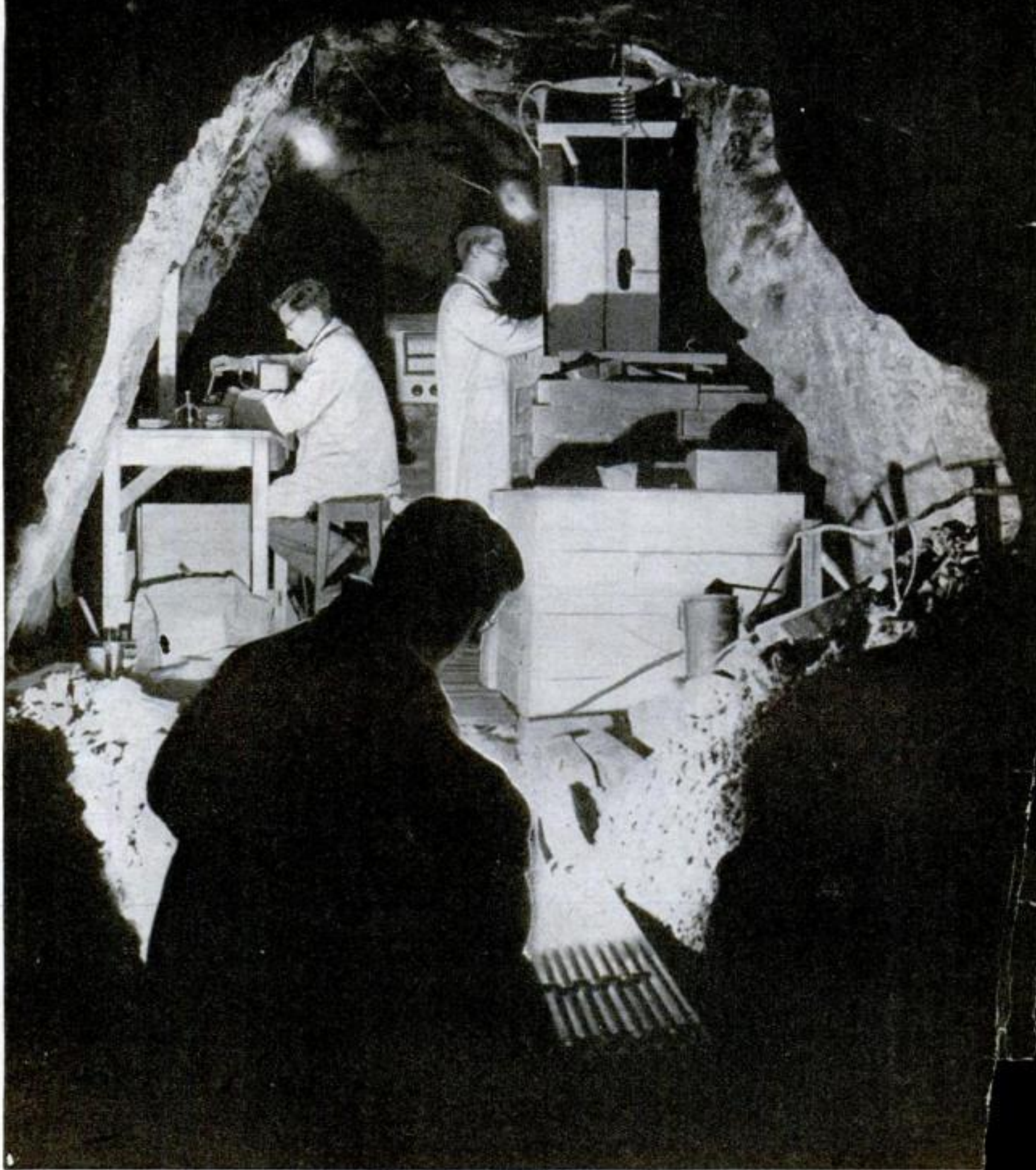
BULLETS spattering from the muzzles of .22 caliber rifles simulate shells from giant field guns on a miniature indoor range that represents 7,500 square yards of battle terrain, in a unique and ingenious artillery practice system worked out by Capt. Louis B. Ely, U. S. Army instructor at the 108th Field Artillery Armory in Philadelphia, Pa. Designed as a new, inexpensive method of training artillerymen, the basement battle ground enables National Guardsmen to engage in practically every phase of artillery fire, control, and observation actually met in the field.

From aerial photographs of the artillery range at Fort Sill, Okla., Captain Ely constructed an accurate model of the terrain,

Observers, left, at ground level watch where bullets from the .22 caliber guns land, radioing the facts to "headquarters"



Cave Is Radium Laboratory



Scientific cave men collecting radon gas for use by hospitals as a safe wartime substitute for

SAFE from air raiders in deep caverns, British experts are collecting radon, the radioactive gas spontaneously given off by radium. The product will be distributed to hospitals all over the British Isles. Since the gaseous emanation emits the same curative rays that radium does, it will serve as well for treating patients. But if it is scat-

tered by an air bomb, its uncontrolled actions will not present the menace from radium, for it loses its activity in a few days instead of many centuries while the radium itself will be kept in an underground laboratory for the duration of the war. The picture above gives a view of the scientific cave men

Train on Toy Battlefield

By A. ERISS

on a scale of one foot to 100 yards, in the armory cellar. Next he developed an intricate system of mounting and controlling low-power rifles so that their aiming, range, trajectory, and other factors would simulate those found in large 155-mm. howitzers. He completed the job by setting up side-line observation posts, an elevated dummy plane cockpit for "aerial" observation, and a comprehensive communication network linking gunners, observers, and fire-control officers. These technicians, together with radio and telephone operators, pilots, staff officers, and other Army personnel can now work out ar-

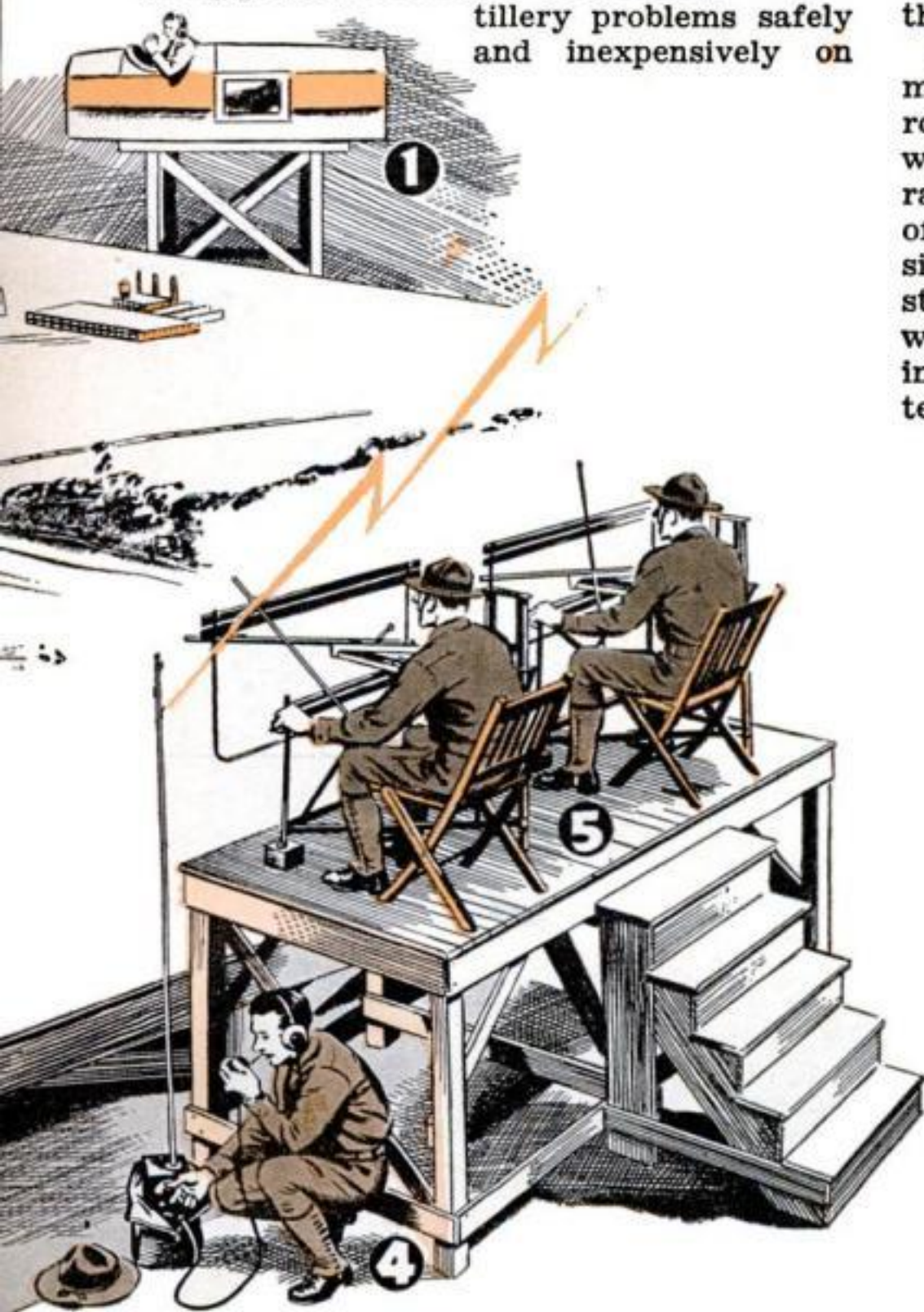
tillery problems safely and inexpensively on



From "headquarters," officers radio the range to gunners

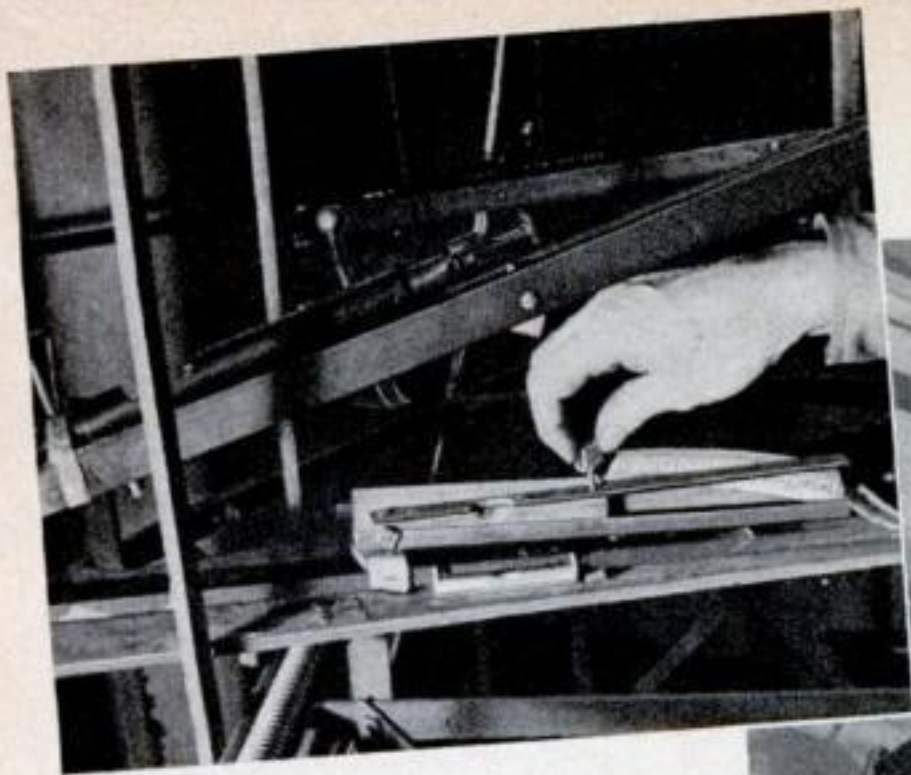
the seventy-five-foot cellar battle site.

All made to scale, "enemy" gun emplacements, toy soldiers, trucks, houses, barns, roads, streams, bridges, artificial hills, woods, and streams dot the miniature terrain, making it exceptionally realistic. Some of the objects are movable. A soldier on the sidelines, for example, can suddenly yank a string to haul a patch of trees out of the way, revealing a hidden column of advancing troops. In this manner, it is possible to test the speed with which a barrage can be



How the miniature battlefield is used to train ground observers, pilots, communications men, officers, and gunners is shown at left and above.

- 1 Observers and pilot in cockpit note locations of enemy lines
- 2 Information is radioed to staff headquarters on another floor
- 3 Staff officers calculate range and radio it to the gun crews
- 4 Radio man receives information, relays it to gunnery commanders
- 5 By means of scales, gunners aim rifles like full-size howitzers
- 6 Trees can be pulled away to reveal enemy troops and artillery



By means of scales as at left, each gun is aimed like a full-size howitzer. Below, Capt. Louis B. Ely, who planned the range, explains the gun to Col. W. A. March, regimental commander

rected by officers in the upstairs fire-control headquarters.

When the guns are fired, the aerial observer in the elevated plane cockpit, and a corps of side-line observers who peer through field glasses and special telescopes, watch the hits. If the shells are landing beyond or short of their mark, or to the right or left, the observers gauge the distance and radio the information to fire-control headquarters. Here adjustments are made and revised orders relayed to the gunnery commanders.



Three Pontoons Stabilize Model Seaplane

AMONG the features of a recent model-airplane exhibit, held in Miami, Fla., and devoted mainly to seaplane models, was the craft pictured at the right with its youthful owner and designer, Arthur Meisner, of Miami. The gasoline-powered seaplane is fitted with three pontoon floats instead of the conventional two, the extra float being between and slightly to the rear of the two others. All three floats are anchored together by wooden crosspieces. Better stability of the plane on the water is said to result.



Note the curious pontoon arrangement used on this seagoing model plane

Soldiers Play Chess with Old Car Parts

LACK of regulation pieces did not stop a group of Scots Guardsmen stationed in the Maginot Line from engaging in off-duty games of chess. Digging around a pile of spare motor parts, they fished out screws, valves, spark plugs, and other items, painted one set white and another black, and made them serve as chessmen. In the lower photograph, bolts with nuts attached are acting as rooks, coil springs as knights, valve covers as bishops, a spark plug as queen, and another plug with a cap screwed on as the king. For pawns, the chess-playing soldiers adopted machine screws standing on their ends.



British soldiers playing chess, and a set of their modernized pieces

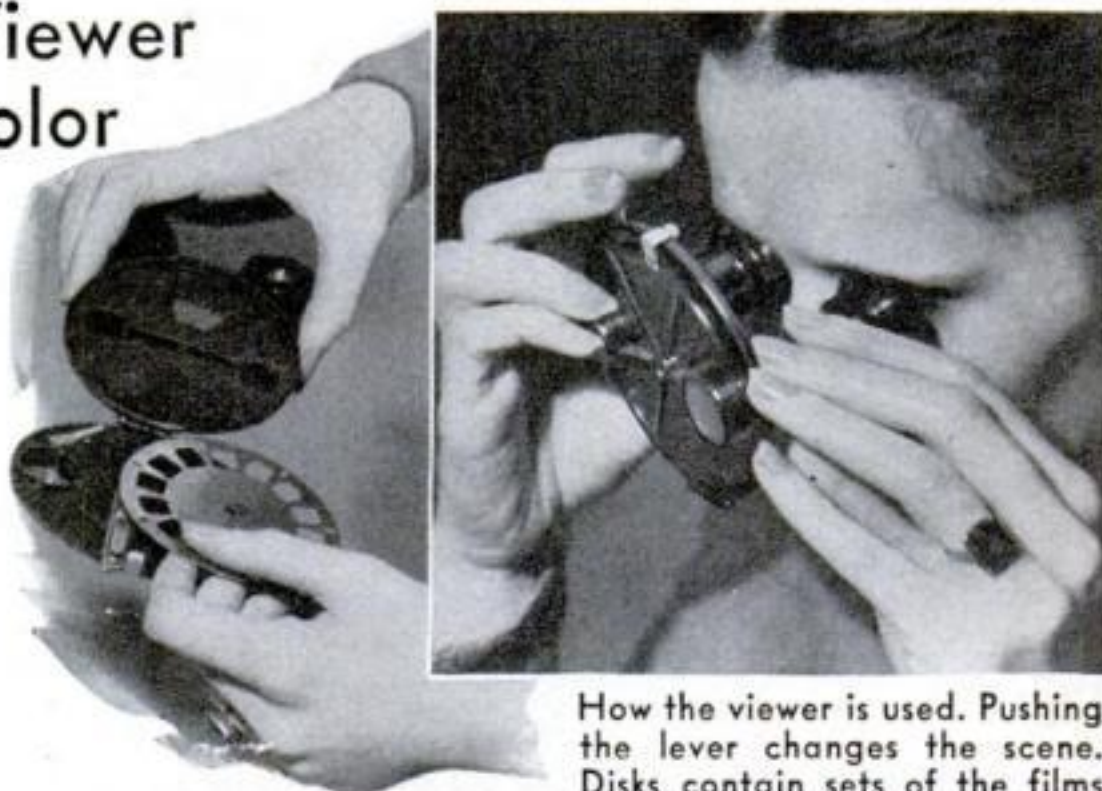


White Bands on Trousers Guard Walkers in Dark

ATTACHING white bands to the bottoms of evening-dress trousers, as pictured at the left, is a new London style note, with the practical purpose of enabling the wearer to be seen more easily in war-darkened streets. The markers are made of a chain of small diamond shapes cut out of white linen and attached to the trousers with studs.

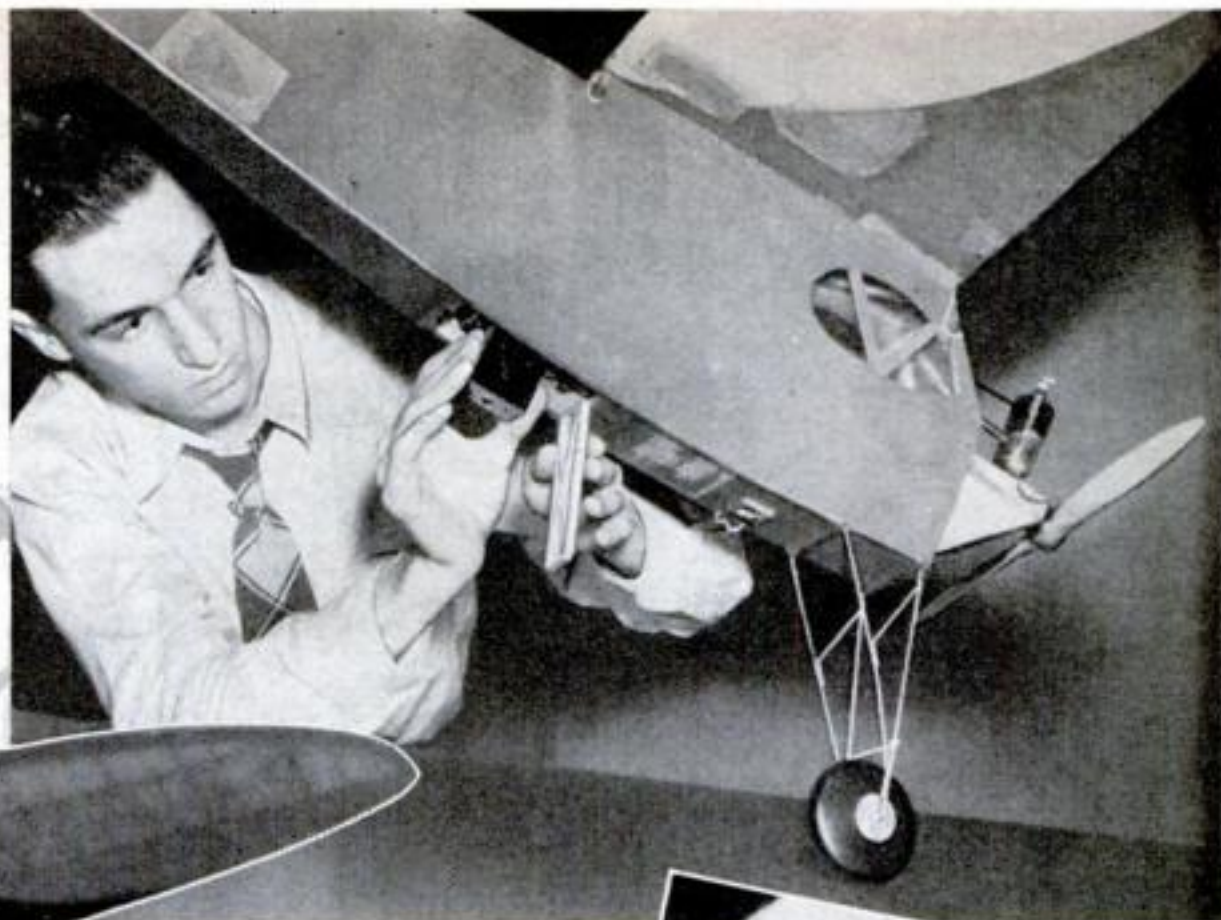
Stereoscopic Film Viewer Shows Scenes in Color

THREE-DIMENSIONAL views in color are provided by the novel stereoscopic instrument pictured in use at the right. Color films are mounted in disks that are placed within the apparatus, which is provided with a small lever at the top for moving successive frames into place before the dual eyepieces. Each disk contains a different set of film pictures. Small pieces of ground glass behind the film insure an even light on the scene viewed.



How the viewer is used. Pushing the lever changes the scene. Disks contain sets of the films

Oliver Pfeil demonstrates how the camera is mounted in the body of the model, with a trapdoor under it



This timing device cuts out the motor, opens the trapdoor, and snaps the camera shutter to take an aerial photograph. At the left is a shot made from the model

Model Photo Plane SHOOTS PICTURES FROM THE AIR

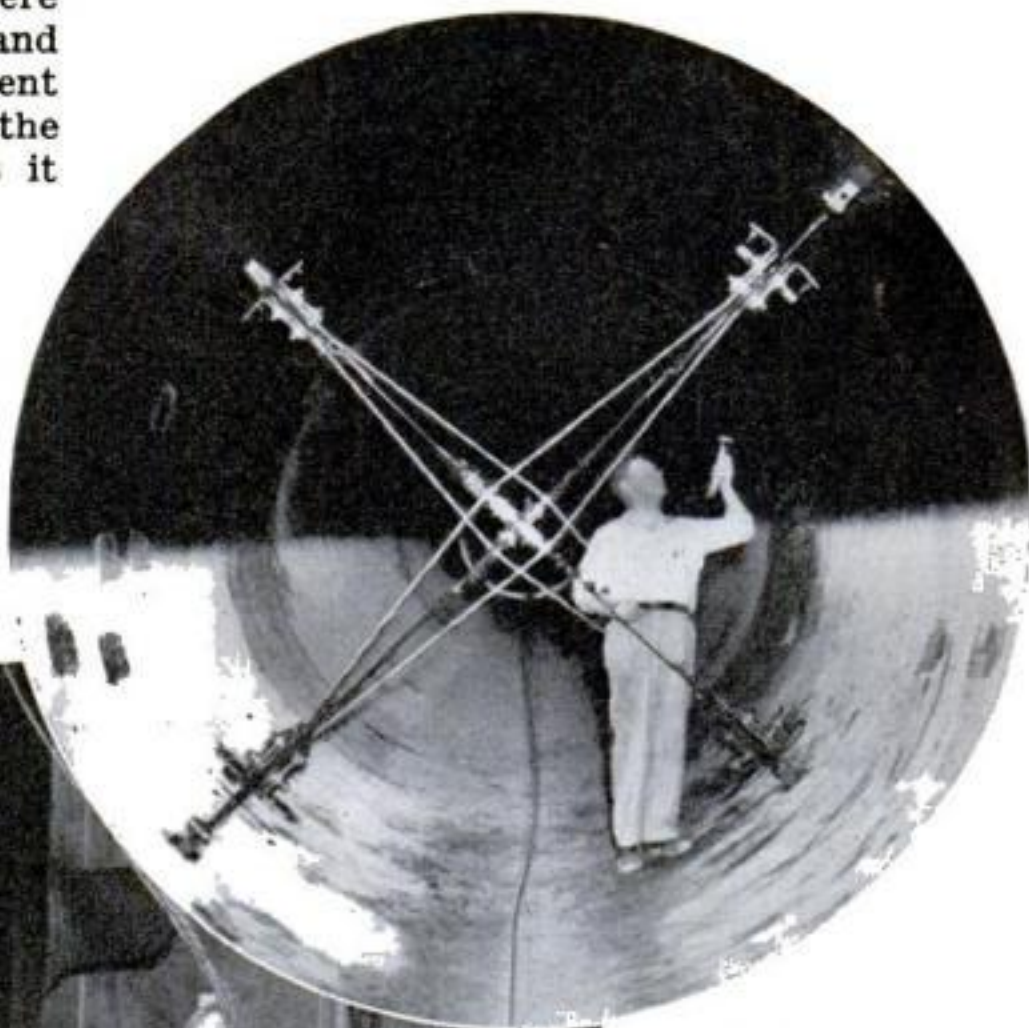
BUZZING through the air at an altitude of seventy-five feet, a model airplane specially adapted by William and Oliver Pfeil, of San Antonio, Tex., snaps clear aerial photographs of the surrounding terrain. Taking a standard model plane, the brothers rebuilt it, replacing with a single landing wheel the former two-wheel arrangement, to compensate for the added weight of a camera. Then they cut a trapdoor in the bottom of the fuselage to accommodate a lightweight camera. When the

plane is ready for an aerial-photographing flight, the trapdoor is fastened shut with a rubber band, a motor-timing device is wound, and the plane is ready for the take-off. About forty seconds after leaving the ground, the timing mechanism cuts out the motor to eliminate vibration, opens the fuselage trapdoor, and then snaps the camera shutter. The camera plane has a wing spread of six feet and is powered by a motor rated at one twenty-fifth of a horsepower. At present, a small camera using 35-mm. film is employed, but the brothers are planning a larger model plane to accommodate a bigger camera that will take even better pictures than those obtained at present.

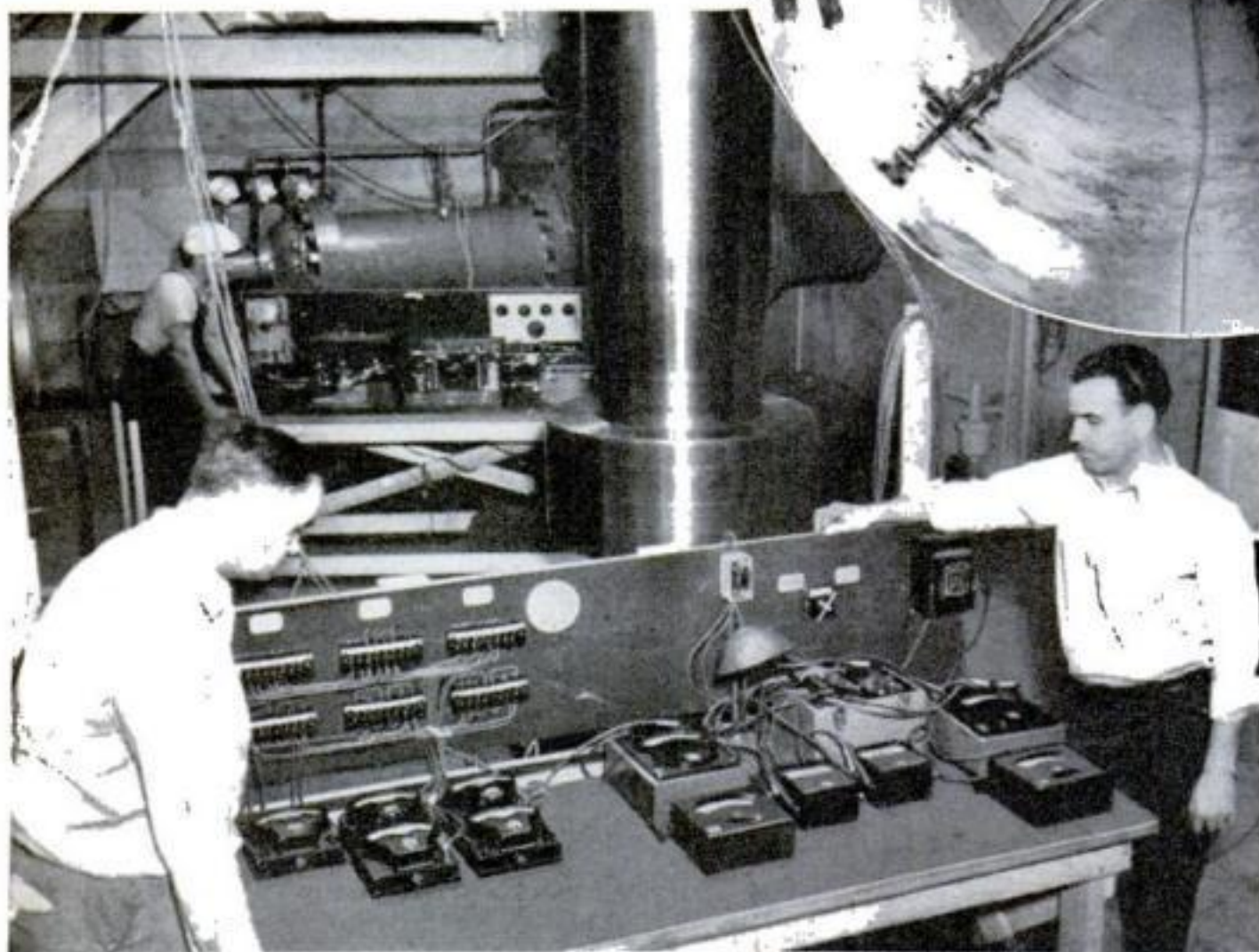
Electric Current Gauges Flow of Water

TO CHECK the efficiency of the giant pumps that push water 1,500 feet up over the southern California mountains into the Colorado River aqueduct, engineers developed a novel electrical system. Two electrodes were placed in each pump's discharge pipe, and then connected to an electrical instrument that recorded on a rapidly moving chart the electrical conductivity of the water as it passed. Concentrated brine was then injected into the pipe a short distance in front of the electrodes. As each "shot" of briny water passed the electrodes, increased electrical conductivity was recorded on the chart. Time factors were also marked on a chart by an accurate clock, so that the distance between "humps" on the chart served as a measure of the time taken

for the water to travel past the electrodes. This time factor was then converted into water volume, thereby giving a check on the working of the pumps.



This X-shaped frame supports electrodes in a pump discharge pipe to measure the water's conductivity



As "shots" of brine pass the electrodes, instruments at left record the resulting changes in the flow of electric current



Wood cylinders linked together provide traction

Handy Raft for Motorists Gets Car out of Ditch

GETTING a car out of a ditch, mud hole, or deep sand is made easy by the use of a novel motoring aid now available. The device consists of a series of cylinders of wood laid crosswise, separated by small lengths of rubber hose, and held in place as a unit by means of a chain. In use, the assembly is first placed on the ground immediately in front of the rear wheels of the ditched car, as illustrated in the photograph at the left. When the automobile is started, the "raft" provides the necessary traction.



When he's done on one side, he'll change climates

Human Sunshine Tester Compares Two Brands

WHICH has the better quality of sunshine, Florida or California? To settle this long-standing dispute, the gentleman at the left is exposing half of his epidermis to Florida's sun, reserving the clothed half for a comparison test in California.

Catcher for Whiskers

ATTACHED to an electric shaver, a new device catches whisker clippings during a shave. The accessory consists of two metal cups hinged to the sides of the shearing head. Since the cutting action of the razor is sideways, the sheared whiskers slide off into the cups, which can be emptied.



Pilot Shoots Scenery with Gun Camera

TO SHOOT aerial views of points of interest along the Atlantic-coast route of an eastern air line, Capt. Glenn J. McDonald, plane pilot, uses a gun camera of the type employed extensively by nature and sports photographers. Mounted on a gunstock, and equipped with telescopic lenses and sights, the camera is aimed out of a window in the transport-plane cockpit. Two triggers are used in taking pictures, one to snap the shut-

ter and the other to move the film for a new shot. The photograph of part of Washington, D. C., shown below, was snapped at an altitude of 1,000 feet.



Capt. Glenn J. McDonald taking a camera pot shot from the window of his cockpit. The aerial view of Washington, D. C., reproduced at the left was made with this gun-type camera

NEW IDEAS

Rainproof Camera Box Keeps Equipment Dry

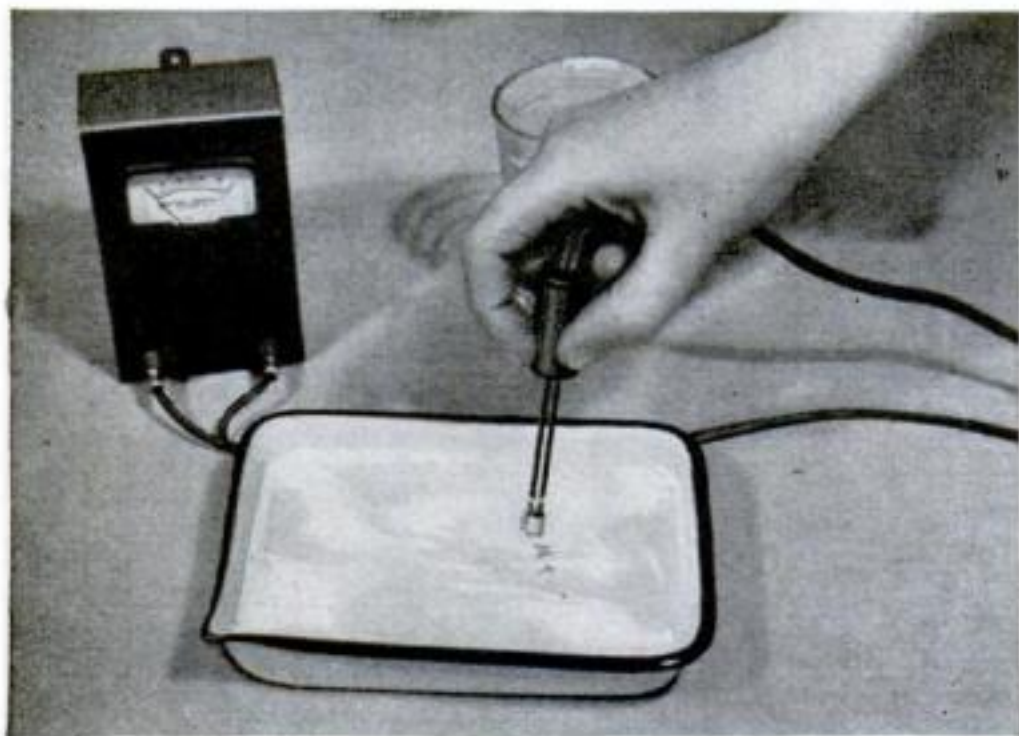
NOT even the proverbial dark and stormy night keeps Emmet W. Odom, Dallas, Tex., newspaper photographer, from getting his pictures. When weather is wet, he slips his camera inside a special waterproof box made of zinc with a wooden base, and fastens it securely with a tripod screw. At night, a built-in view finder permits him to sight on his subject with the aid of a midget flash light also housed inside the box. The focusing knob and film holders are readily accessible through convenient openings, while over the electric switch and wires of his synchronized flash gun is a sheet of rubber cut from an inner tube. The whole outfit is thus adequately protected against a downpour.



Both camera and flash gun are protected from rain

Meter Shows Hypo in Water

INDICATING instantly the presence of hypo in water, the meter shown in use below tells you when your films have been completely freed of hypo by washing, and thus may be safely dried. It is sensitive to one part hypo in 10,000 parts water.



The meter shows the presence of any hypo in the wash water

Clock Is Built Into Darkroom Safelight

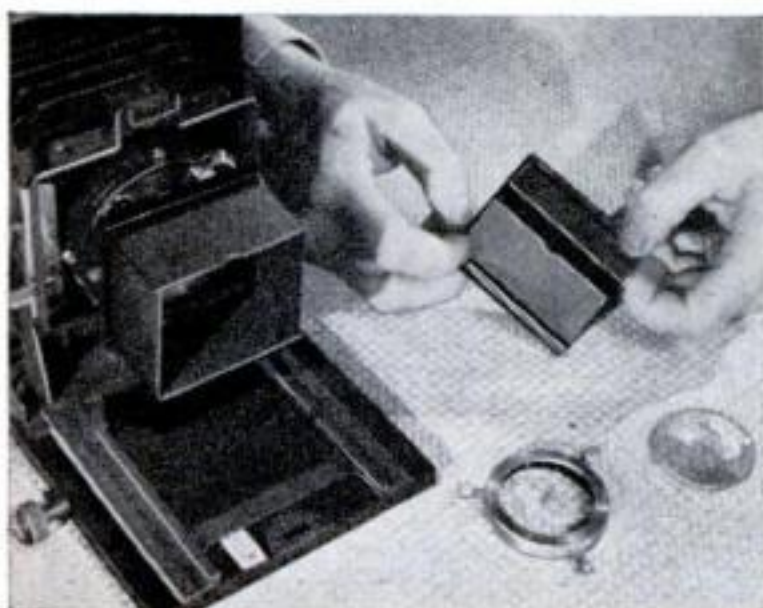


A CHOICE of red, deep-green, or amber light for the darkroom is provided by the unit shown above. The fixture has a built-in electric clock which is illuminated by the glow from the light, while a large second hand on the clock makes a handy timer for darkroom operations.

FOR CAMERA FANS

Lens Shade Folds Up When Camera Is Shut

FOLDING flat so it may be left on when the camera is closed, or removed and conveniently carried in a pocket, a lens shade just marketed attaches easily to a mounting ring that fastens securely by means of three set screws to the lens barrel. Filters available with the outfit can be attached and used even though the lens shade is left in place on the camera. It can be used on several types of folding cameras.



How the shade appears on and off the camera

Adjustable Dodger

IN A new enlarging dodger, a disk containing holes of various sizes and shapes rotates over a lower disk containing one large hole. In use, any hole may be selected and the size of the hole may be altered by slight adjustment of the disks.



The dodger in use. Its openings are variable



Coating Doubles Lens Speed

BY A process of coating a camera lens under vacuum with a chemical layer only four millionths of an inch thick, Dr. C. Hawley Cartwright, of Massachusetts Institute of Technology, doubles the photographic speed of the lens. The treatment reduces surface reflection on glass almost to a vanishing point, permitting added light to penetrate the lens.

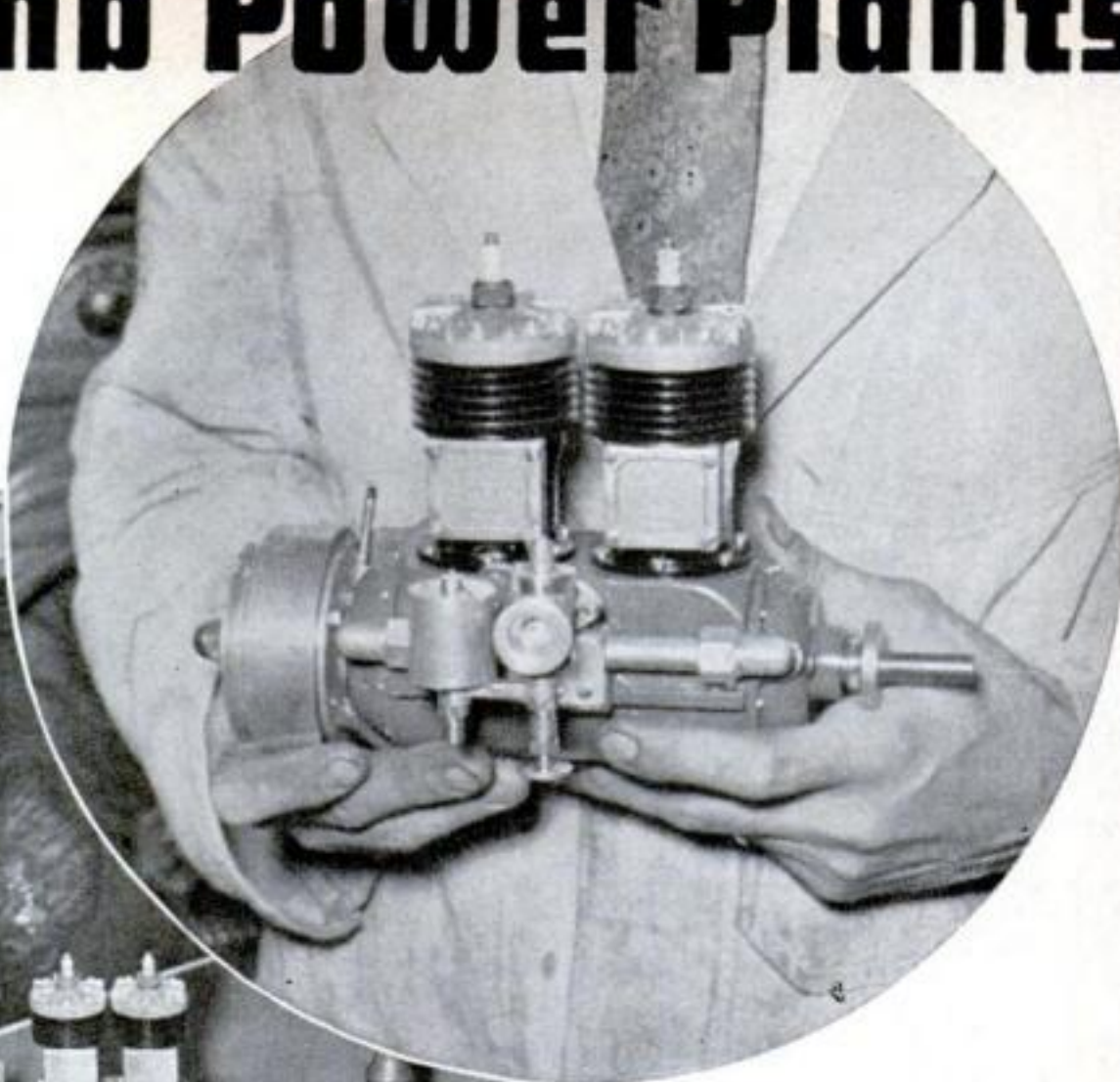
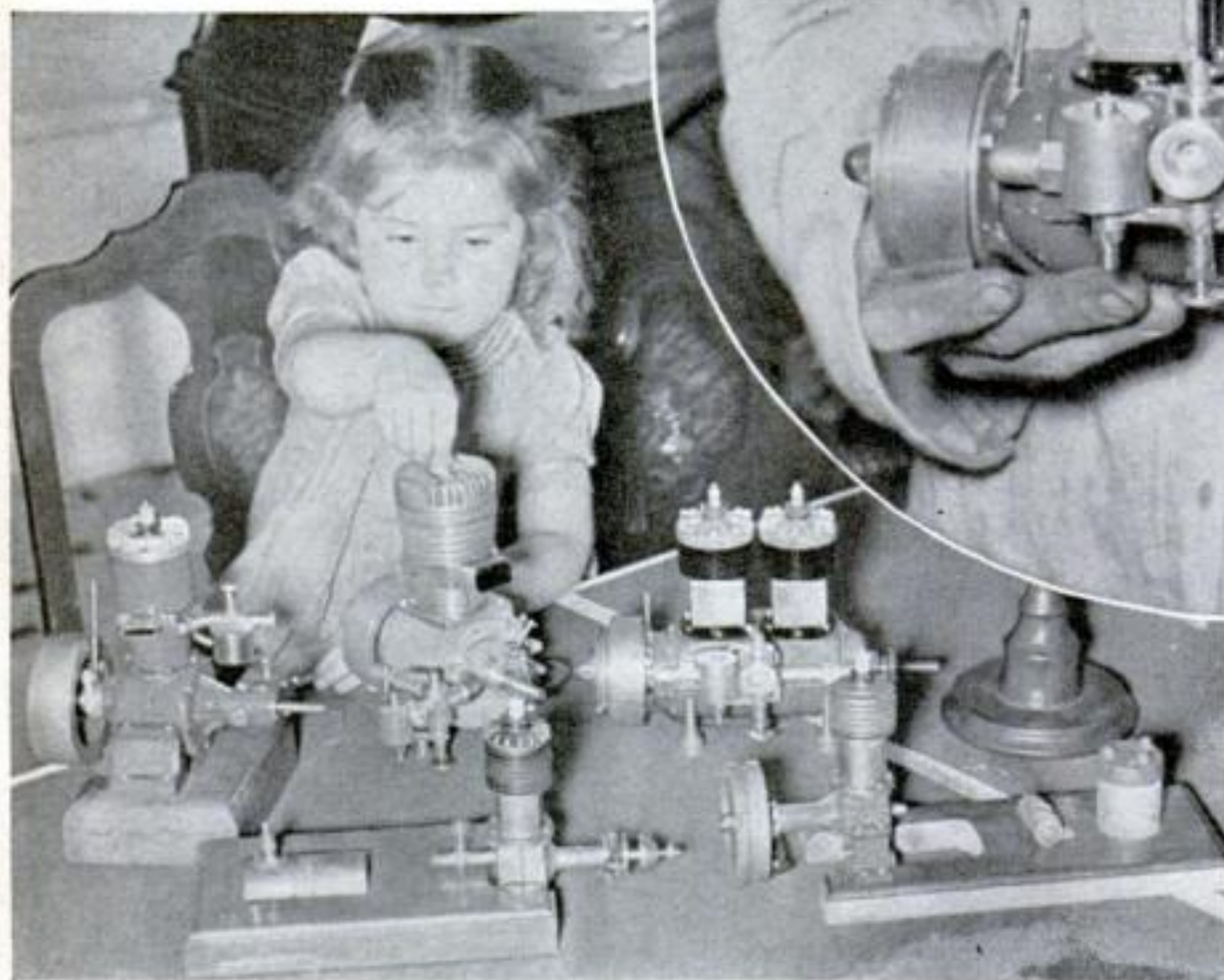
Electric Flash-Bulb Tester

PLUGGED into a house-current outlet, the tester illustrated at the right instantly shows whether any type of bulb, including photoflash bulbs, is good. Pressed into a convenient socket on top of the device, a perfect bulb causes a red signal lamp on the cover to glow.



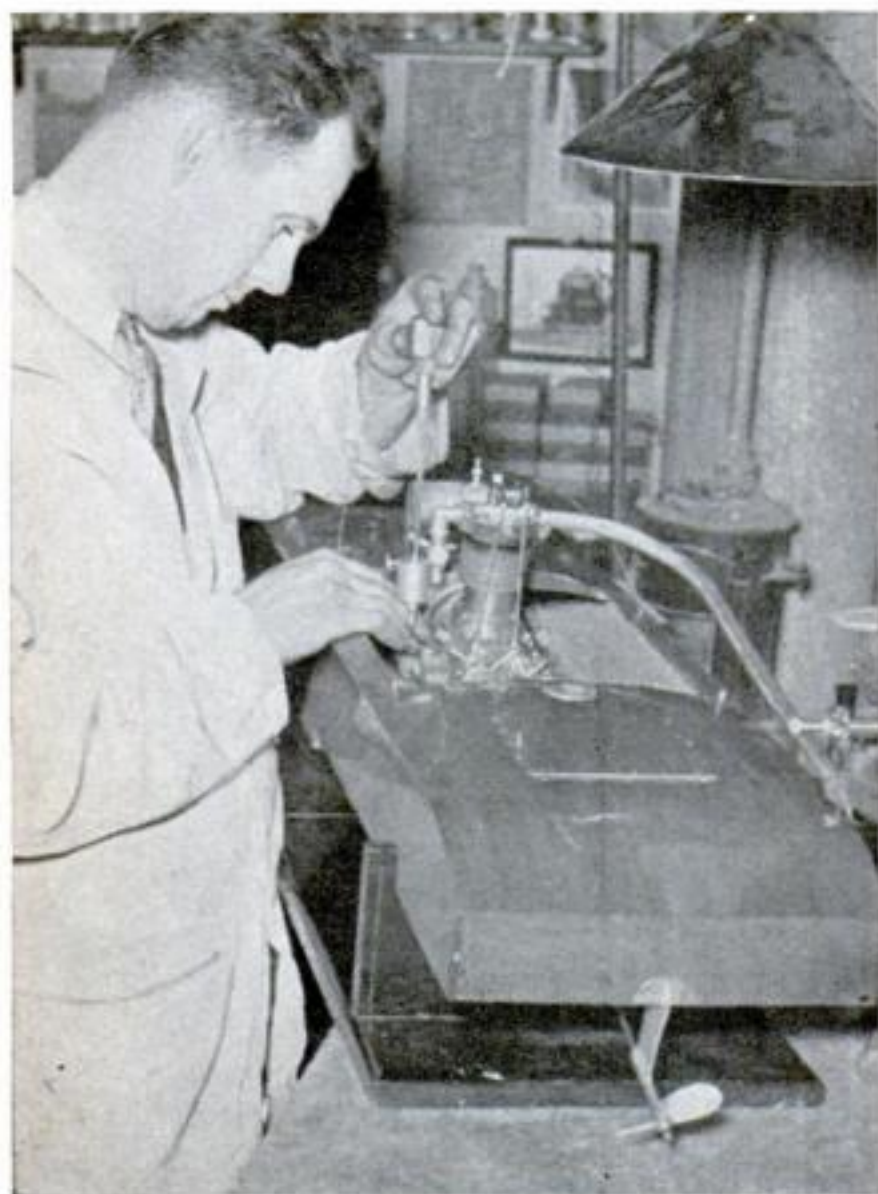
Tom Thumb Power Plants

**GARAGEMAN
BUILDS TINY
ENGINES AS
A HOBBY**



A two-cylinder gasoline engine built by Ralph S. Damon. It has specially designed rotary valves

Patty Damon with a few of her father's motors. The one at front, left, was the first he built

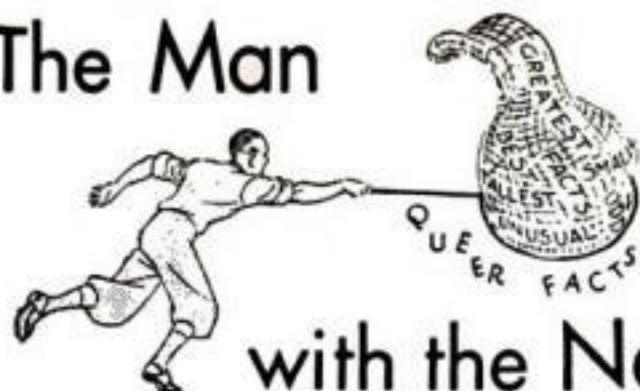


DESIGNING and constructing miniature power plants to drive homemade model planes and boats is the hobby that occupies the spare time of Ralph S. Damon, a Willoughby, Ohio, garage mechanic. Damon's engines, operating by compressed air, steam, and gasoline, are unusual in that they represent his own ideas of small-motor design, and are worked out, cast, and assembled entirely in his own basement home workshop. One of his most unusual models is a two-cylinder, two-cycle gasoline engine equipped with special rotary valves, one on each end of the crankshaft. Other models include water-cooled gasoline engines of the marine type, radial airplane engines driven by compressed air, and steam-powered marine engines for model-boat propulsion. The first power plant Damon built was a single-cylinder gasoline engine that has since powered many a model-airplane flight. That was six years ago.

The miniature-motor maker working on the engine of a model hydroplane

Since then, he has turned out two miniature engines every winter.

The Man



with the Net

BLUE WHALES develop 500 horsepower when they are swimming at a speed of twenty-seven knots.

FAT MEN can consume more alcohol without becoming intoxicated than thin men, as a rule.

FLUORESCENT INK, glowing under ultra-violet light, was used in printing a recent supplement to an American magazine.

400 KINDS of plants eat insects.



OH WELL, THERE HAVE TO BE A FEW CASUALTIES!

STAINLESS-STEEL coins are being minted in Italy.

HISTAMINE, a chemical liberated when the skin is injured, has been found to cause the pain of a pin prick or a cut.

TREES of more different species grow in the Great Smoky Mountains National Park than are found in all Europe.

WOODEN "rubbers" are worn over shoes in southern Chile during rainy weather.

FROGS can croak under water.

LOTS'A PEOPLE HAVE "CROAKED" UNDER WATER TOO!



VERMONT has a greater average snowfall than many parts of the Arctic.

BARNACLES are degenerate relatives of lobsters and crabs.

TWINS are more likely to be born to older than to younger parents.

BRIDGEPORT is the name of twenty-one different communities in the United States.

HELP!



Placed on the drawing paper, the rule is adjusted by means of extension arms for drawing any desired curve



New Drafting Instrument Forms Any Desired Curve

DRAWING curves and arcs is made easy for draftsmen and engineers by a new instrument worked out by James E. Bell, municipal engineer in Kansas City, Mo. The device, shown in use above, employs a flexible steel band connected to a circular center-piece by straight adjustable arms, which are moved in or out to regulate the curvature of the band as required.

Cigarette-Pack Protector

TO MAKE cigarette packages crushproof, tobacco dealers are now giving customers a cardboard container that fits over the pack to protect the cigarettes.



Cigarettes won't be crushed in this cardboard case

Handy Helps



CLIP-ON BASIN RACK. Attached easily to the lower edge of an apron-type bathroom wash basin or kitchen sink, the rack pictured above provides handy extra space for hanging towels and wash cloths. It is specially convenient in a tiled bathroom where additional fixtures are needed. Clipped upside down to a closet shelf, it will serve as a necktie rack



DOUBLE CLOTHESPIN. Shaped like an inverted "V," a new-type clothespin has double prongs which make it possible to fasten adjacent pieces of wash to the line without overlapping. This is said to save trouble and give uniform drying



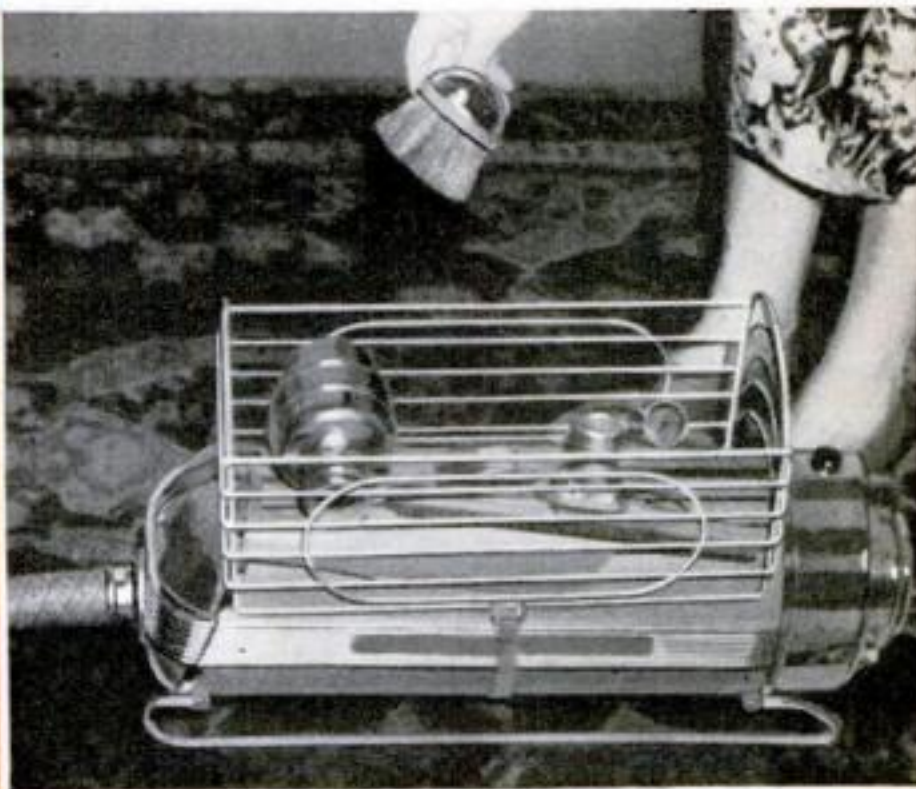
ROAST HOLDER. Carving a leg of lamb or mutton is simplified by the ingenious holder shown above. A decorative thumb screw clamps it firmly to the bone, for easy handling



FIREPLACE SPIDER WEB
Made of pipe cleaners, cellulose tissue, and silk thread, the spider-web novelty at the left creates unusual effects in the fireplace. When ignited, the spider gives off colored flames while the web burns around it

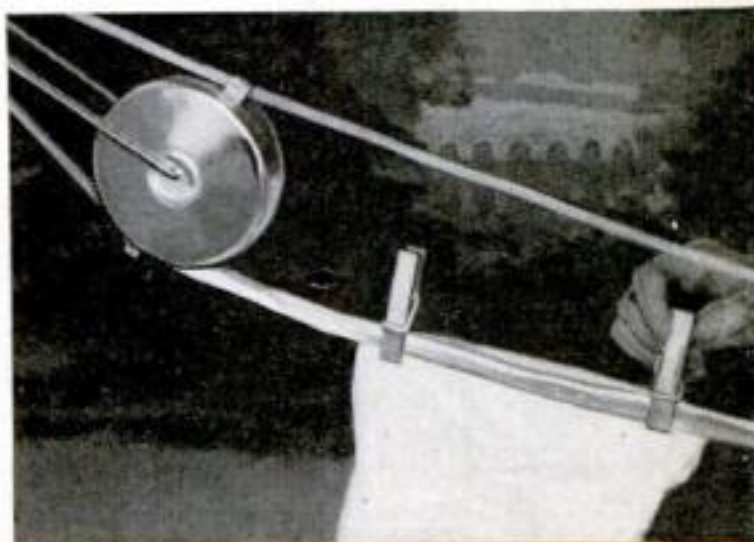
for Homemakers

COFFEE DISPENSER. Designed especially for use with glass-type coffee makers, the attachment below measures out the amount of coffee needed to make a cupful of the brew, each time the lever is moved as illustrated



RACK FOR CLEANER GADGETS. Extra nozzles, brushes, and other accessories for a cylinder-type vacuum cleaner are kept always at hand in a basket of wire strapped snugly to the top of the cylinder

CLOTHESLINE COVER. Dirty outdoor clothesline cannot soil freshly washed clothes if it is covered with a paper tape that unreeles from a can which is attached to the clothesline hook. The paper is torn off the line and thrown away after use. The can contains a 400-foot roll



FLOWERPOT WRAPPERS. By the use of decorative wrappers made of a special rubber product, flowerpots are made more attractive and are prevented from marring furniture. The wrappers come in roll form and are easily applied to pots as shown at right



POPULAR SCIENCE

Question Bee

Are you up on your scientific subjects? If you are, you should be able to answer at least sixteen of these posers. When you've taken a whack at them, turn to page 230 for your score



- 1 If the inner horses of a merry-go-round are traveling at ten miles an hour, the outer horses are going (a) faster (b) slower (c) at the same speed.
- 2 No two people have ever been found to have the same (a) type of blood (b) number of vertebrae (c) fingerprints.
- 3 Even a weak person can lift a heavy car with a jack, because of its (a) kinetic energy (b) coefficient of expansion (c) mechanical advantage (d) period of vibration.
- 4 Three fourths of the metal in a five-cent piece is (a) lead (b) copper (c) nickel (d) tin.
- 5 The historic U. S. warship *Constitution* has often been called (a) Old Hickory (b) Old Glory (c) Old Ironsides (d) Old Faithful.
- 6 An integer is (a) a wild ass of western India and Baluchistan (b) any whole number (c) part of an automobile's rear axle.
- 7 In chemistry, the opposite of oxidation is (a) liquefaction (b) reduction (c) catalysis (d) ionization.
- 8 Circles having the same center are called (a) eccentric (b) concentric (c) meta-centric (d) centrifugal.
- 9 You would find a gnomon on (a) a sewing machine (b) a modern motor car (c) a sundial (d) the national flag of Portugal.
- 10 What makes safety matches safe is that their heads contain no (a) phosphorus (b) oxidizing agent (c) combustible chemical.
- 11 Seismology is the study of (a) the moon (b) tree rings (c) earthquakes (d) precious stones.
- 12 When a turtle draws into its shell, all you see of it is its (a) chrysalis (b) swimmeret (c) pineal body (d) carapace.
- 13 A solid geometrical figure with four sides goes by the name of a (a) cube (b) prism (c) tetrahedron (d) parallelepiped.
- 14 You would use a niblick in (a) fencing (b) bowling (c) golf (d) polo.
- 15 As an example of a conifer, you might point to (a) a tornado (b) a crawfish (c) Mt. Vesuvius (d) a pine tree.
- 16 Ethylene gas sometimes is used (a) to fumigate ships' holds (b) to ripen fruit artificially (c) as a toxic vapor in warfare.
- 17 The flame of a laboratory Bunsen burner is said to "strike back" if it (a) makes a bang when it is turned off (b) travels down the tube and burns at the base (c) changes spontaneously from yellow to blue.
- 18 A derrick's long slanting arm is called its (a) gaff (b) boom (c) skip (d) pitman.
- 19 Slow-motion movies could be made by (a) slowing down the camera (b) speeding up the camera (c) running the camera backward (d) using special film.
- 20 If you chased a gibbon, it would probably (a) gallop away (b) burrow into the ground (c) climb a tree (d) take to its wings.

Now YOU Ask One!

Perhaps you, too, can think up amusing questions that will stump other readers! We pay \$1 for each one accepted. Address the Question Bee Editor, Popular Science Monthly, 353 Fourth Avenue, New York City.

Un-Natural History *By Gus Mager*

"AS BLIND AS A BAT" DOESN'T MEAN A THING! WHILE ITS EYES ARE SMALL, THE **BAT** HAS UNCOMMONLY GOOD VISION AT NIGHT, AND EVEN IN THE DAYTIME IT SEES WELL ENOUGH!



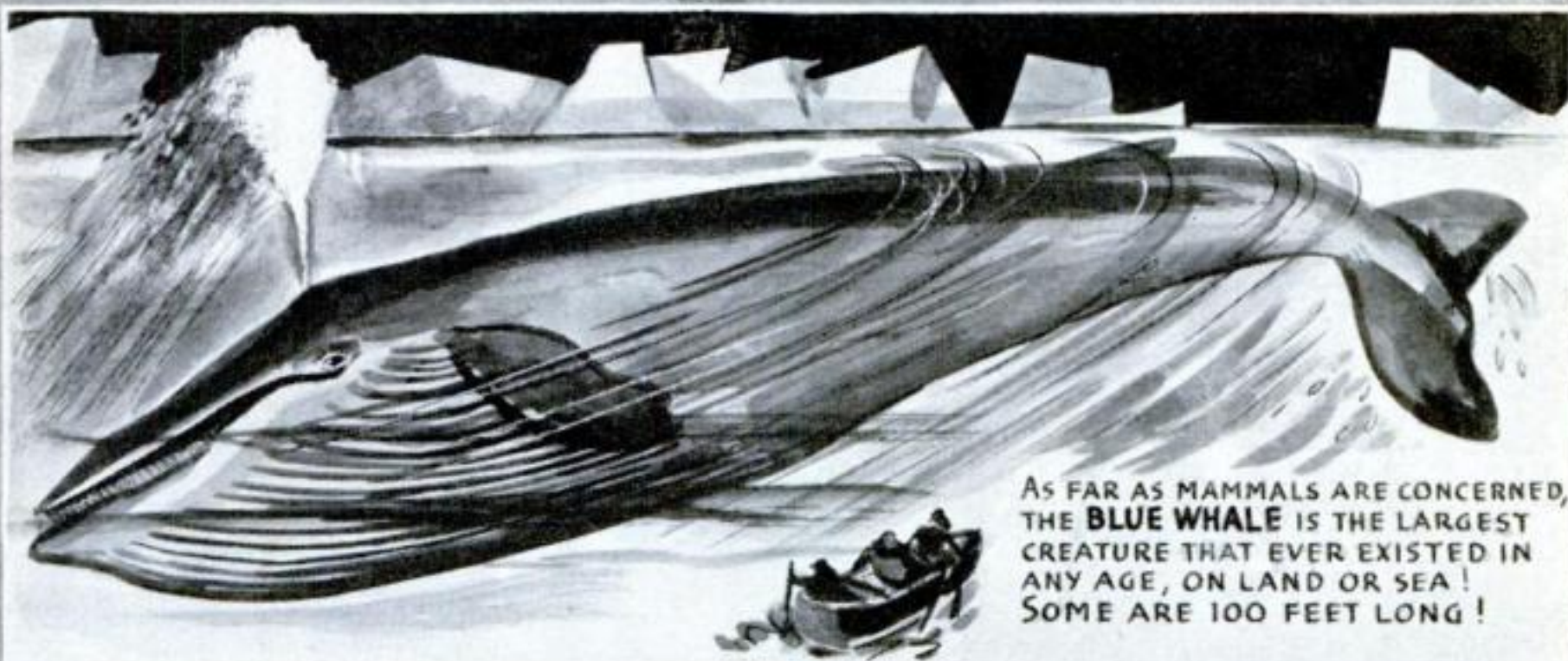
THE **BRACKET FUNGUS** ISN'T ASHAMED TO TELL ITS AGE! GROWING ON THE BARK OF A TREE, IT PUTS ON A NEW RING FOR EVERY YEAR IT LIVES!



NEST



A TRAVELING INCUBATOR IS THE MALE **KURTUS FISH**, OF NEW GUINEA! HE HAS A DEEP, HOLLOW NEST IN HIS FOREHEAD, IN WHICH HE CARRIES EGGS UNTIL THEY HATCH!



AS FAR AS MAMMALS ARE CONCERNED, THE **BLUE WHALE** IS THE LARGEST CREATURE THAT EVER EXISTED IN ANY AGE, ON LAND OR SEA! SOME ARE 100 FEET LONG!



THE **MAN-OF-WAR FISH** MAKES ITS HOME AMONG THE DEADLY, STINGING TENTACLES OF THE PORTUGUESE MAN-OF-WAR! A THICK COATING OF SLIME IS SAID TO PROTECT IT!

ASIATIC
WILD
CRAB
APPLE



**BISMARCK
APPLE**
(NEW ZEALAND)

ANCESTOR OF THE **APPLE** IS A TINY FRUIT ABOUT THE SIZE OF A CHERRY, WHICH STILL GROWS WILD IN SOUTHERN EUROPE AND ON THE SHORES OF THE BLACK AND CASPIAN SEAS.

**WILD APPLE
OF EUROPE**

By
**MARTIN
BUNN**



Gus ran his hand along the gas line, mounted on the frame channel. He whistled when he felt that it was warm

GUS SOLVES A DOUBLE PUZZLE

GUS WILSON looked up from the disassembled fuel pump on which he was working when a black business coupe was driven in through the open doors of the shop of the Model Garage. He grinned and began a cheerful greeting when Dave Sledd opened the car's door, but Sledd didn't give him a chance to do more than get started—he was talking fifteen to the dozen before his feet hit the shop floor.

"I just can't figure it out, Gus," he said. "The engine runs swell, and the whole darned bus *seems* all right. But I can't get her up over a couple of miles over forty an hour, even when I jam the pedal right down to the floor boards. I've watched the speedometer hand again and again; forty-two or forty-three is the best she'll do. She's been

that way for the last week. I've been intending to bring her in to you, but I've been busy as the devil, and it really didn't make much difference so long as I was just running around town. But the first thing the boss told me when he got in the office this morning was that I've got to go away up-state today to smooth down a new customer who's having a little trouble with one of our machines—and that I'd better step on it so

I'd have a chance to get him happy before his factory's closing time. I didn't have the nerve to tell the old man that the car isn't running right. He would have crawled my frame plenty for not having had it attended to. Look her over and fix her up in a hurry, will you, Gus? Give me a call at the plant when you get finished. I'll be all ready to start."

The energetic Sledd had started for the door before he had finished talking. "Hey!" Gus yelled after him. "I'm working on another rush job, and I can't stop now to go hunting bugs in that bus of yours. You'll have to wait until . . ."

BUT Sledd was through the door. He didn't answer and kept right on going. Gus grinned broadly. "That guy Dave's like a flea," he confided to Harry, the grease monkey. "He hops around so fast you never can get your finger on him. Well, I suppose I'll have to take a look at his car, Johnson and Frederick being our biggest customer. Guess you can put this pump together, can't you?"

Harry assured him that he could put the pump together, and Gus started to check Sledd's car. The ignition system tested out all right. The carburetor was O.K. So was the fuel line. The clutch wasn't slipping. The brakes weren't dragging.

Gus tilted his black mechanic's cap over his left eyebrow and scratched reflectively back of his right ear. "What the heck!" he said finally.

"Stumped, hey?" Joe Clark, his partner in the business of the prospering Model Garage, had come into the shop from the office and was standing behind him.

"Yep. Stumped!" Gus admitted without shame. "Engine runs smooth, everything else seems all right, but the job won't do over forty-odd. At least Dave Sledd says it won't. Well, I guess there's nothing for it but for me to take it out on the road and see for myself."

He reached for his coat, but Joe stopped him. "Wait a minute," he said. "Mr. Hubbard just called up and wanted to know if you will have his car ready by eleven—he will need it then. It's after ten now."

"Darn!" Gus growled. "Hubbard's car has me stumped, too. Sledd needs his right away, and . . ."

"Tell you what," Joe interrupted. "You and Harry go ahead on the Hubbard job, and I'll take Sledd's bus out on the road. Maybe I'm no part of a mechanic, but I am pretty sure that I can

When a Cop Says You Were Doing Sixty-Five, Take His Word for It! Gus Did, and That "Slow" Car Was Fixed

read a speedometer as well as you can."

After Joe had driven out, Gus went back to work on the fuel pump. He and Harry had reassembled it and were replacing it on the Hubbard car when Joe came back. "Sledd's dead right," he reported. "His car runs fine, but forty-three was the very best I could get out of it. . . . There's the phone."

He hurried into the office, and Gus stared at Sledd's car and then at the Hubbard sedan. "I don't mind a double puzzle," he remarked, "but I'd rather work out one half at a time. Now, Harry, you . . ."

A motor cycle sputtered to a stop outside, and Trooper Jerry Corcoran, of the State Police, came jauntily into the shop—broadbrimmed hat tilted rakishly, blue-gray uniform immaculate, belt and boots polished to mirrorlike brightness. "Hi!" he greeted. "Anything wrong around here?"

"Wrong?" Gus said. "No, there isn't anything wrong—except that I've got a couple of jobs on hand that have me down. What do you mean, is there anything wrong?"

"Why," the trooper explained, "a few minutes ago I saw Joe Clark coming up the road in Dave Sledd's coupe. He was hitting it up at sixty-five. I've never seen him drive over thirty-five before, so I thought that maybe there was something the matter up here at the garage."

Gus stared at him. "Sixty-five?" he said. "You sure about that?"

"Sure I'm sure!" Jerry maintained stoutly. "I stayed behind him for half a mile, and kept one eye on my clock. I was going to whistle him down and give him a ticket, before I saw who it was."

Gus started to laugh. "I am dumb!" he said. "Hey, Joe! Here's Jerry Corcoran



"He was hitting it up at sixty-five," the trooper maintained

—and he has a speeding ticket for you!"

Joe Clark's outraged face appeared at the office door. "Speeding ticket!" he snapped. "You're crazy, Jerry! The limit's fifty on that road. I was watching my speedometer, and I was doing forty-three!"

"Yeah? Well," said Jerry, "I was watching *my* speedometer, and you were doing sixty-five—and if I wanted to I could make that stick as tight as a drum in court!"

"I was kidding about the ticket, Joe," Gus said. "But Jerry's right. You *were* doing sixty-five. Give Dave Sledd a call and tell him there's nothing the matter with his car—except that his speedometer is twenty-two miles slow! Tell him to bring it in when he gets back from his trip, so we can send it down to the service people and have it fixed."

"There's half of our double puzzle solved," Gus commented to Harry after Sledd had called for his car and driven it out. "Now we've got to solve the other half." He frowned at the Hubbard sedan. "I've blown out the fuel line, taken the fuel pump apart and cleaned it, and cleaned and adjusted the carburetor. I've checked the fuel line near the exhaust and at the gas tank, and there's no vapor lock. The engine runs fine at idling speed. Now I'll take it out and see if it runs fine on the road. It should!"

"What's the matter with this bus, anyhow?" Harry wanted to know. "I wasn't here when Mr. Hubbard brought it in."

"The matter with it," Gus said, "is that it will run a little way, and then stop dead. After a few minutes you can start it again. Then it does exactly the same thing. It drove Hubbard nuts coming up from the city yesterday. I took it out, and it acted just the way he said it did."

He drove out. Three run-of-mine repair jobs came in during the half hour he was gone. When he got back he found Harry up to his eyes in work, and the shop jammed with cars. To get the Hubbard job out of the way while he did some shifting around Gus drove it over the greasing pit, leaving the engine running when he got out. "How's she doing?" Harry asked.

"Bad as ever!" Gus growled. He got down into the pit and felt the connection of the gas pipe at the tank. It was tight. Aimlessly, he ran his hand along the gas line, which was in the channel of the frame. He

whistled when he found the line distinctly warm near the rear of the muffler. Close inspection revealed a small three-cornered hole in the muffler where its rear plate connected with its body. The car, he guessed, had been driven on a deeply rutted road, with the result that the muffler had come in contact with the road and had been bent sharply upward.

"Harry!" he called. "Get in the car and speed up the engine!"

Harry speeded up the engine. Gus felt a blast of hot exhaust shoot out of the muffler onto the gas line. "Shut her off," he said. "And bring me a piece of asbestos and some wire."

He wrapped the asbestos around the muffler so that it covered the hole, and secured it with the wire. Then he climbed out of the pit. "Run her a couple of miles,"

he told Harry, "and see how she acts."

Harry was back in ten minutes. "Runs swell," he reported. "No trouble at all."

"That's part two of our double puzzle solved," Gus said. "Tell Joe to call Hubbard up and tell him he can have his car."

"Sure," Harry said. "But say, Gus, what was the matter with the bus?"

"Vapor lock," Gus told him. "But not where I had looked for it. When the engine was idling, the exhaust gas coming out of that hole in the muffler wasn't hot enough to do any harm. But when the engine was speeded up, it came out in a blast that caused the gasoline in the fuel line to vaporize—and, of course, the engine stopped. After the line had cooled off a little, you could start the engine again. But when you speeded it up you had the same thing all over. That asbestos will do the trick for a few days, but we'll have to order a new muffler for Hubbard—we haven't one in stock. Tell Joe, will you?"

"Sure. Say Gus," said the young mechanic with a puzzled look on his grease-smeared face. "How come Sledd and Joe couldn't tell from the 'feel' of that car that it was going faster than forty? I could..."

"Look here, young fellow," interrupted Gus. "Think you could go out and sell like Dave, or keep books the way Joe does?"

"No," replied Harry, thoughtfully.

"You sure couldn't! Now go tell Joe about the muffler and get back to work and show me you can do that. Step on it!"

Harry stepped on it.

GUS SAYS:

Take your car to the cleaner's now! It's time to get the salt and other ice-melting chemicals that cities put on the streets in the winter cleaned off the underside of your car. If left on, they can do a lot of harm through corrosion and rust of vital metallic parts.

THE HOME WORKSHOP



In This Issue.. **AUTO PAINTING • VACATION MOVIES
FURNITURE • JIG-SAWING • SHOP HINTS**

HOW TO TOUCH UP
DAMAGED SPOTS OR APPLY
A NEW COLOR COAT OF LACQUER OR ENAMEL

Repainting Your Car

By Ralph G. Waring

AUTO refinishing today is a most diversified business. The actual space and equipment needed for the work, as well as the requisite heat and light, are readily available, but other things are also essential. These are skill in matching colors, knowledge of how to do the work, and the proper technique in handling spray guns, abrasive papers, and rubbing compounds. All require experience, and unless a car owner has some ability along these lines, it is better by far to have the work done by a reputable painter and finisher. For successful refinishing, you should preferably have portable spray equipment and, of course,



Spraying on the finish coat. The windows and all chrome-plated trim or other bright work must be masked by using masking tape and newspapers

At right, the preliminary coats of primer-surfacer, which have been sprayed on, are being rubbed with waterproof paper and water



suitable materials for the work. A warm, bright day is necessary, and a clean garage. If you do not have a sprayer, you can still do the work satisfactorily provided you have good, clean brushes that have been properly kept in liquid brush keepers. You can then use the new four-hour, synthetic-resin type auto enamels and turn out a good job at considerable saving in cash. Don't attempt it, however, unless your garage is not only clean and well lighted, but can also be kept free of flies on a warm, bright day.

If your car was originally finished in lacquer, the same type of finish can be used again. A simple way to test the old finish is to sand a small section with dry sandpaper. If the paper gums up, the finish is lacquer; if not, it is enamel. If you decide to refinish with lacquer, it will have to be sprayed on, not brushed. Lacquer is a hard drying and relatively inflexible coating with powerful solvents that attack the undercoats, so it can be used only over lacquer-base coatings. Enamel, which is made on an oil-resin base, can be applied over any sound, tight base coating, whether lacquer, enamel, or varnish.

If the first finish on your car was enamel, then that alone should be used for the new coat. As conditions warrant, it may be applied with either the gun or brushes, except that in the latter instance a special thinner must be purchased to slow up the initial set of the enamel to allow the brush marks to flow out properly.

What you Save

Materials required for a typical touch-up lacquer job on a damaged car door:	
2 sheets No. 180 abrasive paper.....	\$0.10
3 sheets No. 280 abrasive paper.....	.15
1 tack rag35
1/2 pt. primer-surfacer.....	.40
1 pt. colored lacquer.....	1.00
1 pt. first-grade thinner.....	.35
1 lb. No. 2 rubbing compound.....	.40
Owners' Cost	\$2.75
Average price quoted by five garages.....	\$6.75
Owner Saves \$4.00	

Materials for a typical recolor job in lacquer:	
7 sheets No. 280, and 3 No. 320.....	.50
1 pt. primer-surfacer.....	.75
1/4 lb. glazing putty.....	.25
1 tack rag35
2 qt. body color (for 2 coats).....	4.00
2 lb. No. 2 rubbing compound.....	.75
(or 1 qt. of No. 7 at \$1.26)	
1 qt. fender body color (for 2 coats).....	2.00
1 package 1" masking tape.....	1.25
2 qt. thinner75
Owners' Cost	\$10.60
Average price quoted by five garages.....	\$35.00
Owner Saves \$24.40	

Materials for a typical recolor job in enamel:	
7 sheets No. 280, and 3 No. 320.....	.50
1/4 lb. glazing putty.....	.25
1 pt. primer-surfacer (if needed).....	.75
1 tack rag35
2 qt. body color (for 2 coats).....	2.50
1 qt. fender body color (for 2 coats).....	1.25
1 package 1" masking tape.....	1.25
4 qt. special thinner.....	1.15
Owner's Cost	\$25.00
Average price quoted	\$8.00
Owner Saves \$17.00	



STEPS IN TOUCHING UP A DAMAGED DOOR

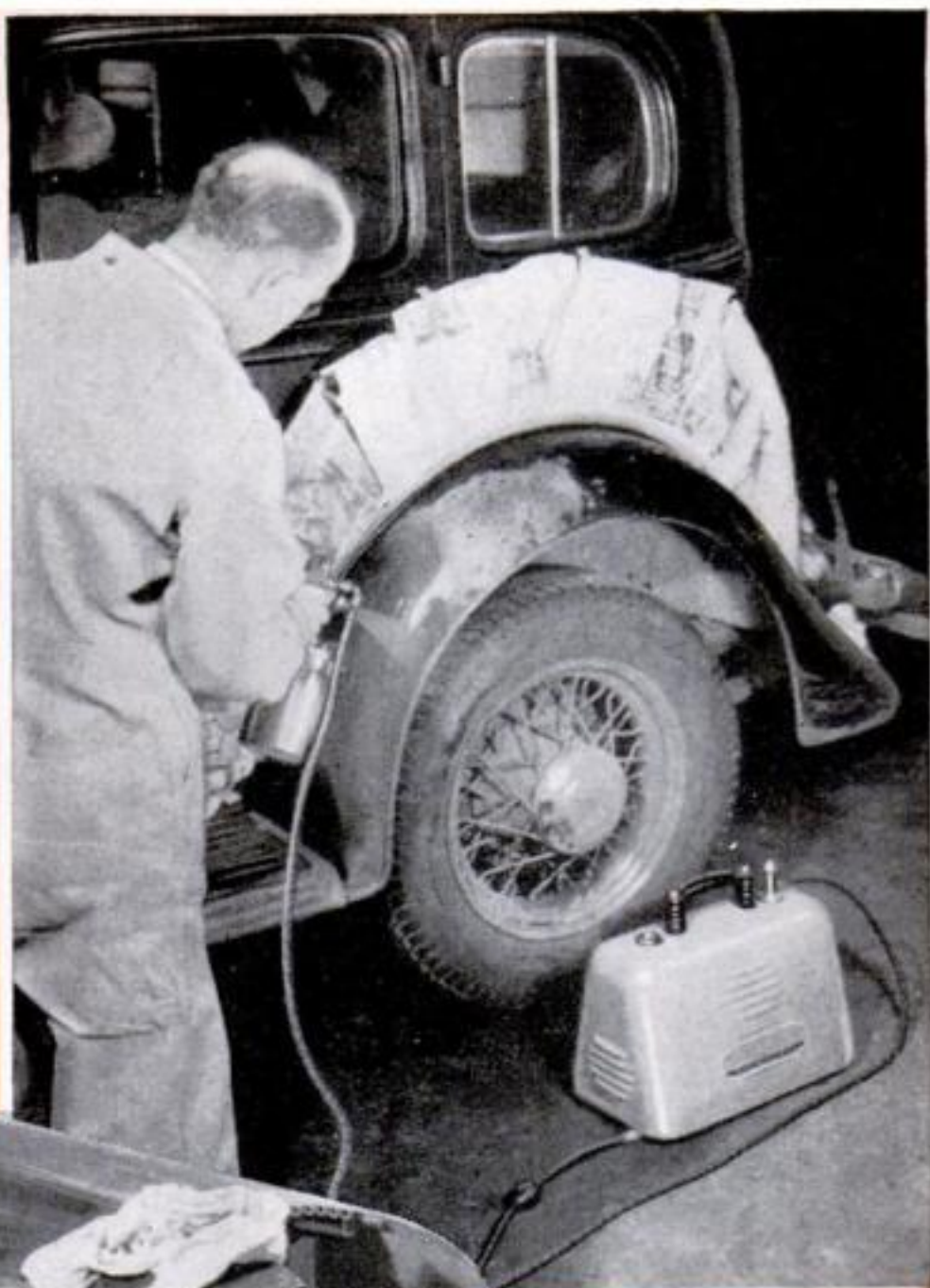


In each instance it is necessary to mask all windows and chromium-plated or other bright work as shown in the photos.

Car refinishing naturally divides itself into three classes: Touch-up jobs, recolor jobs (top coat only), and the hand-brushed auto enamel finish. The necessary materials are listed in the tabulation marked "What You Save." Prices may vary to some extent. The estimates mentioned were obtained from five garages which specialize in auto paint-



The final coat, if lacquer, is allowed to dry for half a day, then rubbed carefully with No. 2 rubbing compound



Above, spraying metal primer on a mud guard which had been so badly scratched in places that it was necessary to wet-sand part of it down to the bare metal

compound or any standard abrasive liquid polish (such as "No. 7") to bring up the color.

2. Feather the edges of the paint down with No. 280 or 8/0 waterproof abrasive paper and water. Sponge clean. Dry.

3. Wipe quickly with a clean cloth dampened but *not wet* with denatured alcohol, or use the commercial cleaning solution supplied by the maker of the lacquer you are using. Do

not touch any surfaces with the hands after this alcohol wipe, and do not use gasoline at any time.

4. Prime with spray coats of primer-surfacer. This material protects the metal, insures adhesion, and builds up a level surface. When sprayed on in *light*, successive coats, the primer-surfacer allows cutting down with abrasive papers to a true surface. Let each coat dry until flatted, or free

ing and are located in the writer's home city, Syracuse, N. Y.

TOUCH-UP JOBS

1. Sand all chipped or scratched areas to the bright metal with fine abrasive papers, preferably No. 180 or 5/0 waterproof abrasive paper and water. Sponge clean. Polish the surrounding areas with No. 2 rubbing

of gloss from the thinners. Apply at least two coats. Dry for half an hour.

5. Wet-sand lightly with No. 280 or 8/0, or No. 320 or 9/0, waterproof paper—just enough to cut down any dust nibs. Level and feather out all edges. Avoid cutting through to the metal. If this occurs, recoat as needed.

6. If the old finish is lacquer, recoat with lacquer color to match. This can usually be obtained from auto refinishing stations if you give the make and color of the car and the year of manufacture. If the old finish is enamel, use a similar new material instead. Wipe off the surfaces carefully with a purchased or homemade tack rag before applying any finish coats. A tack rag is merely a lintless cloth which has been rendered slightly tacky with varnish so that it will pick up the dust.

7. Spray a light, even coat and let it dry in order to judge the color match. Tint the color, if necessary, by using japan or lacquer colors, which can be purchased in tubes or 1-lb. cans as needed. For very small areas that require matching, you can use artists' tube colors. It is often best to spray an entire fender or door rather than try to match perfectly a small patch. If this is done, any small difference in color is not likely to be noticed.

8. Apply a mist coat. Let this set from five to ten minutes, and then give a double coat (one up and down, the other from left to right) just wet enough to obtain a good flow and level out properly, but not enough

to cause any sags. Watch this very carefully in the case of enamel coats.

9. Let dry half a day in summer, or at 75 to 80 deg. F. in winter, then rub out with No. 2 compound for lacquer coats. Do *not* rub enamel, but leave in full gloss.

RECOLOR JOBS

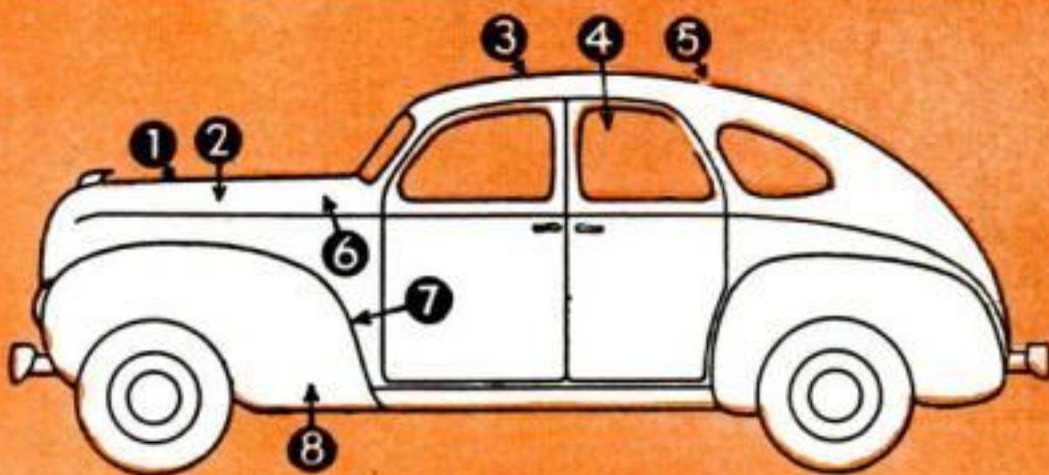
1. Wash the car clean with warm water and a half cupful of trisodium-phosphate powder to a pail of hot water. Hose off clean.

2. Sand all scratches and defects down to the bright metal. Cut the entire finish down dull, using water and No. 280 or 8/0 waterproof paper to level out all parts of the surface. Now apply spot putty on all dents and abrasions not cut down by the sanding. These auto-glazing putties are specially prepared and cannot very well be made at home. They are sold in tubes or cans and can be purchased locally or directly from finishing manufacturers. Keep all putty spots thin and light, and rely on successive coats for building up a dent rather than one heavy application, which might shrink on drying. Dry hard between applications, then water-sand down level.

3. Spray all puttied spots and bare portions with primer-surfacer in successive light coats. Dry thirty minutes and sand level with No. 320 or 9/0 waterproof paper and water. Dry carefully.

4. After carefully dusting car with a brush, go over it again with a commercial

Here's the Order to Follow When Using Lacquer



1. Sand from top down on hood, cowl, and right side complete.

2. Repeat on left side. Blow the dust out of the window frames and all body seams.

3. Wash top with special cleaning fluid or diluted alcohol.

4. Mask all windows and chrome trim.

5. Dust off turret top with tack rag. Start to spray on front right corner to belt lines, across and over. Repeat immediately on left side. Give two coats, one following the other.

6. Clean spray dust off of the cowl, lower part of body, and rear fenders. Wipe with tack rag. Spray these sections.

7. Clean spray dust off front fenders and hood, use tack rag, and spray the finishing coat on rear fenders and lower part of body.

8. Spray cowl, front fenders, and hood. Let set fifteen minutes, then apply the finishing coat.

9. Let harden half a day, and then rub with No. 2 compound and polish.



The new synthetic-resin auto enamels can be brushed on over an old finish of either the lacquer or the enamel type. Sketch at upper left shows spot-glazing a dent

HAND-BRUSHED AUTO ENAMEL

1. Clean the garage. Wet overhead and the side walls to keep down all traces of dust.

2. Clean the car and wash it ready for painting. Avoid soap powders. Use the trisodium type, which makes no suds yet easily removes all traces of wax and oil.

3. Wet-sand all parts with No. 280 or 8/0 abrasive papers to cut the old surface down clean and smooth. Wet-sand to the bare metal as necessary over any deep scratches. Dry thoroughly.

4. Prime the exposed metal surfaces with an oil-base metal primer, which is the only type that can be brushed. Dry four hours, then sand with No. 280 or 8/0 and water. Dry off and tack-rag, then recoat. Dry hard and resand with No. 320 or 9/0 paper and water. Cut down level, and feather out all edges. Dry thoroughly.

5. Spot with glazing putty as needed. Dry hard. Sand level with No. 280 or 8/0 paper and water. Dry thoroughly.

6. Apply a brush coat of primer-surfacer to all the putty spots. Dry hard and wet-sand with No. 280 or 8/0.

7. Inspect the entire job and spot-sand as required. Before starting the enamel work, sprinkle the garage floor again. It pays to keep walls dampened down, too. Dust off and tack-rag just ahead of the brush work.

8. Use brushes freshly cleaned in pure turpentine or special thinner made for reducing the enamel to brushing consistency. The special thinner must be obtained in any

or homemade tack rag to insure the complete removal of all traces of dust.

5. Spray on an undercoat of light to medium weight on the spot-sanded areas only, just as for a new finish, whether lacquer or enamel. Dry thirty minutes for lacquers and four hours for enamel undercoatings. Water-sand lightly to remove any nibs, using No. 320 paper and water. Dust off and tack-rag again.

6. Spray two good, wet coats without inducing any sags or drips. For enamels, let set not less than from ten to fifteen minutes, and then spray on a full-bodied coat within an hour, so as to give good anchorage, coverage, and body, but without inducing sags, especially on vertical surfaces. For lacquer coatings, let set half a day and then rub out with No. 2 compound. Finish with an abrasive liquid polish, if available, and dry cloths. (No. 2 and No. 7 serve about the same purpose and either will do.) Wax the finish, if desired, to obtain an extra bright gloss.

case, since the enamel itself, if made for auto finishing, is made to be used in the spray gun and, therefore, has too fast an initial set or surface hardening to flow out readily under the brush unless mixed with the thinner. Thin the enamel and work the brushes in a small portion of it until the bristles are satisfied and all traces of the thinner have left the heel of the brush. Then discard this small amount of paint.

9. Apply coatings of the thinned enamel solidly and evenly to the car. Do the portions farthest away first, and fenders and the like last. Plan the work carefully before starting and use a tack rag on separate areas just ahead of the brush. Avoid sags on the vertical areas. Be sure to study the accompanying illustrations carefully before starting work.

10. Keep all coated work clean by lifting out any lint or bristles. For this work use a ball of burnt varnish on the end of an applicator stick or wire to touch the lint while the enamel is still wet and flowing. To pre-

pare the picking stick, cook six to eight parts of brown rosin and one part of varnish in a clean vegetable can until a hot drop let fall on a cold glass plate cools and forms a stiff pill. Take a ball of this about the size of a shoe button, shape it round with wet fingers, and apply it to any specks of lint in the still wet enamel coating. The enamel flows together again as the lint is lifted out.

11. Dry hard and wet-sand with No. 320 or 9/0 paper and water if a second coat is needed to obtain full depth and color. Dry thoroughly after washing clean. Tack rag off and recoat as needed.

12. Allow the final coat two days to dry before putting car in service.

13. Wheels can be washed, sanded wet, dried, and brush-coated or sprayed as needed. For this work they are removed, and some method of supporting them about 36" from the floor should be used in order to see better the progress of the work and also eliminate tiresome bending over.

Table with Reversible Top Can Be Used for Playing Chinese Checkers



One side of the table top is a Chinese checkerboard; the other side is plain for general use. Either side fits securely on the cross brace

DESIGNED by the Peekskill (N.Y.) Homeworkshop Club, this combination Chinese checkerboard and utility table is an excellent project for the lathe. The top is removable so that either the game board or the plain side may be used; it also can be lifted off to serve as a tray.

The construction of the stand presents no difficulties. The legs are mortised into the pedestal. In making the top, glue up 1" boards and turn to shape. Lay out the Chinese checkerboard on one side and bore $\frac{1}{2}$ " holes $\frac{3}{16}$ " deep. The cross brace must fit snugly inside the rim as shown. Sand the entire piece thoroughly and finish as desired.

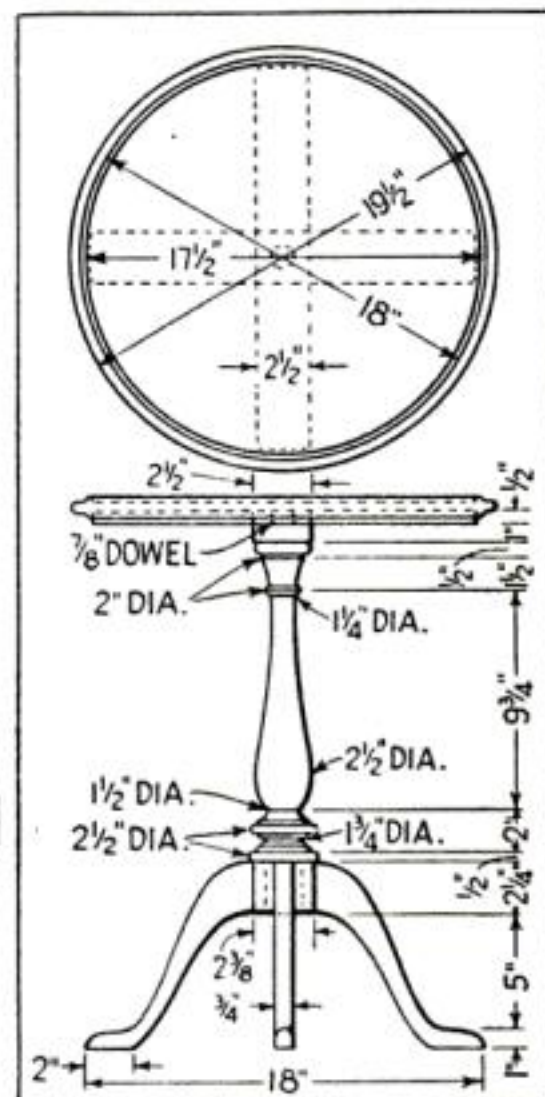
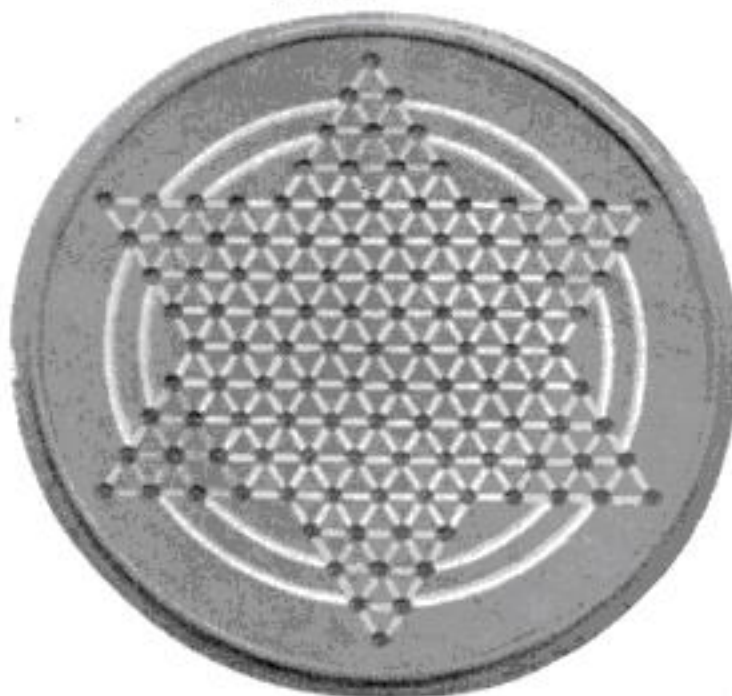
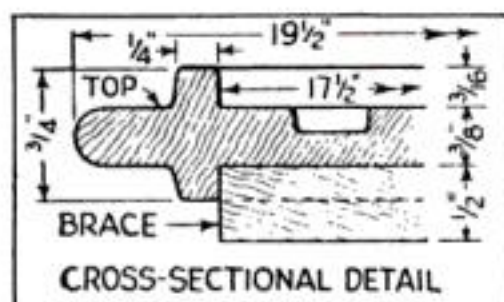


Table Game Played with Bottle Caps

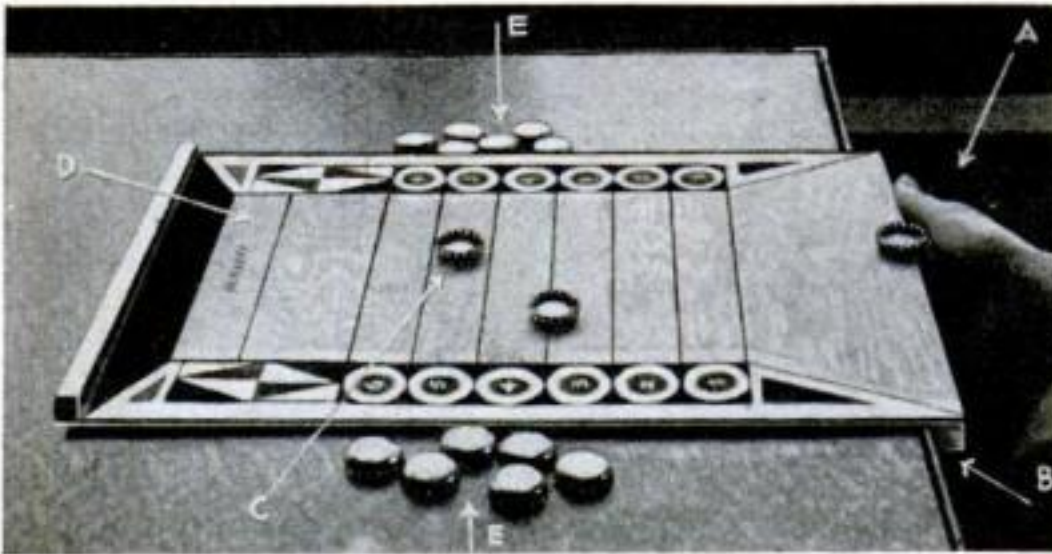


"CAPS" is a game played with bottle caps, nickels, or metal washers. The board may be ruled on any smooth surface or table, but the one illustrated is made of polished plywood. Dimensions are unimportant, but make the six scoring spaces a little wider than the diameter of the counters.

To shoot a cap, it is placed as at A and struck smartly with the thumb. A strip B keeps the board firm. A cap is shown in scoring position at C, and D is the penalty space. Caps ready for use are shown at E.

Each player shoots three caps up the board. If a cap stops in a numbered space and is clear of the lines, it scores and is placed upside down on the number of the scored space. Each player takes the numbers on one side of the board. When a cap goes into the penalty space, the player loses one point of score and has to take one cap off a number at his side of board, as designated by his opponent. A shot may be taken again if the cap fails to reach the first line. As soon as a player has covered all six numbers, he has won a game.

The number of games to be played should be decided at the start.—CHARLES BOROUGHS.



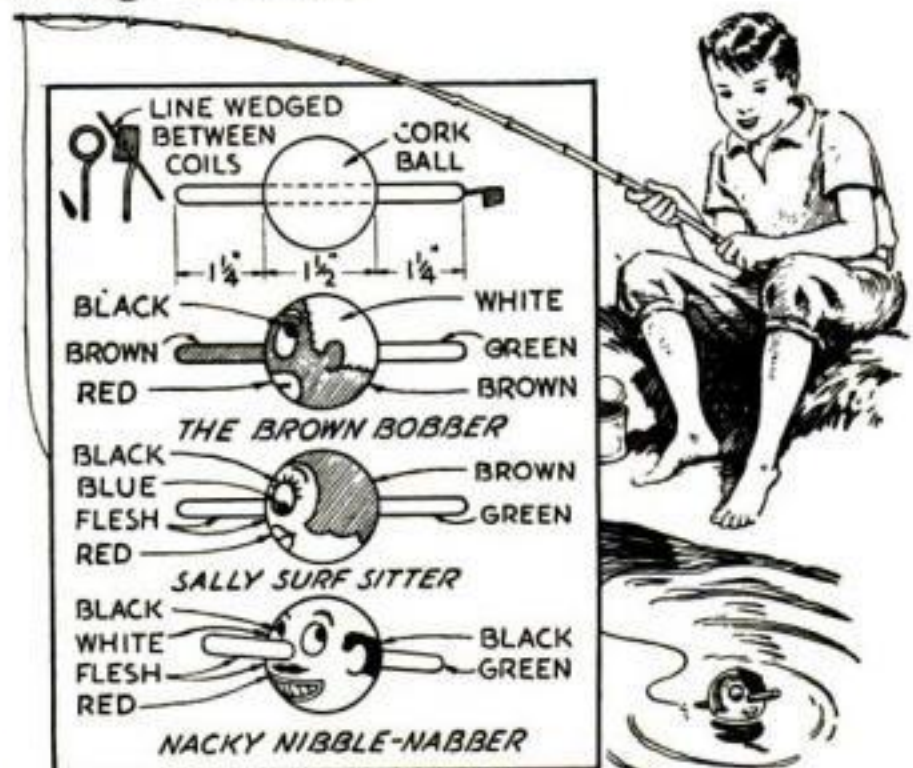
To score, a cap has to stop in one of the six numbered spaces. If it touches one of the lines, it does not count

Funny Faces Decorate Fishing Floats

FISHING floats with painted faces form amusing novelties for any angler's tackle box. The cork balls used by the writer are $1\frac{1}{2}$ " in diameter. All holes and depressions are filled with composition wood or other filler. Apply a coat of shellac over the entire float, then finish with quick-drying enamels. It is almost as easy to make half a dozen floats as one. The floats you can't use yourself may be given to friends or placed on sale in your neighborhood sporting-goods store.—CARL L. SORESENSEN.

Wire Solder Ties Fowls

INSTEAD of using twine to tie the feet of fowls that have to be carried from place to place, one farmer uses short pieces of wire solder to wrap around the legs. Solder provides a secure binding without inflicting any injury.



Three suggestions for amusing cork floats. The corks are obtained from a sporting-goods store

AN ORDINARY horseshoe magnet fastened to the end of a stick will enable an invalid who does needlework to pick up small steel articles such as needles and pins without stooping.—R. MARTELL.



By DOUGLAS DAWSON

HOW steady is your hand? This simply constructed electric game will tell you. It may be used for pleasure at private parties or for profit at fairs and carnivals.

The test is merely to move a metal ring over a long metal tube so steadily that it does not touch at any time. If it does touch, a bell rings and the player scores the number opposite the point to which he succeeded in moving the ring.

Obtain a piece of brass or copper tubing about 36" long and $1\frac{1}{2}$ " in diameter. If this is not available, wrap a good electrical conductor such as bare copper wire or thin sheet copper or brass on a round wooden bar of the same dimensions. The rod may be supported at each end in any convenient way. One simple method is to use two ordinary coat hooks and spring the lower hook out sufficiently to receive the tubing.

Drill a hole lengthwise through an insulating handle of wood, or use a piece of fiber or composition tubing. Thread a length of flexible insulated copper wire through the handle and solder it to a brass ring $1\frac{3}{4}$ " in inside diameter (or 2" if you desire an easier game). Fasten the ring to the handle. Be sure that all parts are well insulated.

Connect the other end of the wire to one pole of a suitable battery, a doorbell transformer, or a toy transformer that will reduce the voltage of the house current to not

ELECTRIC GAME

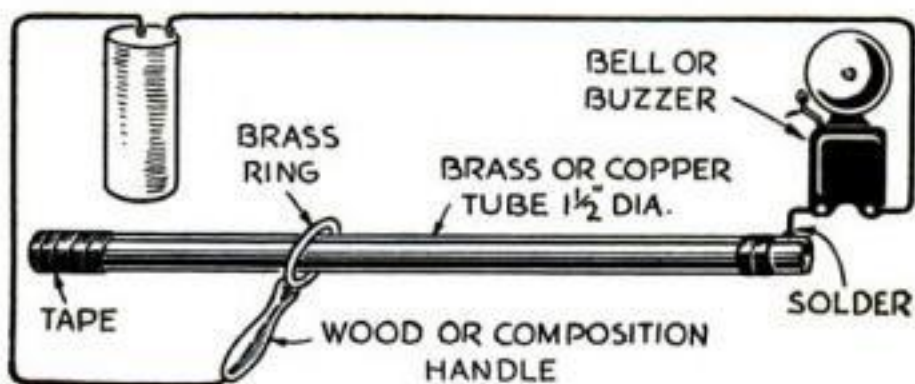
TESTS STEADINESS OF HAND

over 6 volts. If a battery is used, place a small switch in the line so that the current can be cut off when the game is not in use.

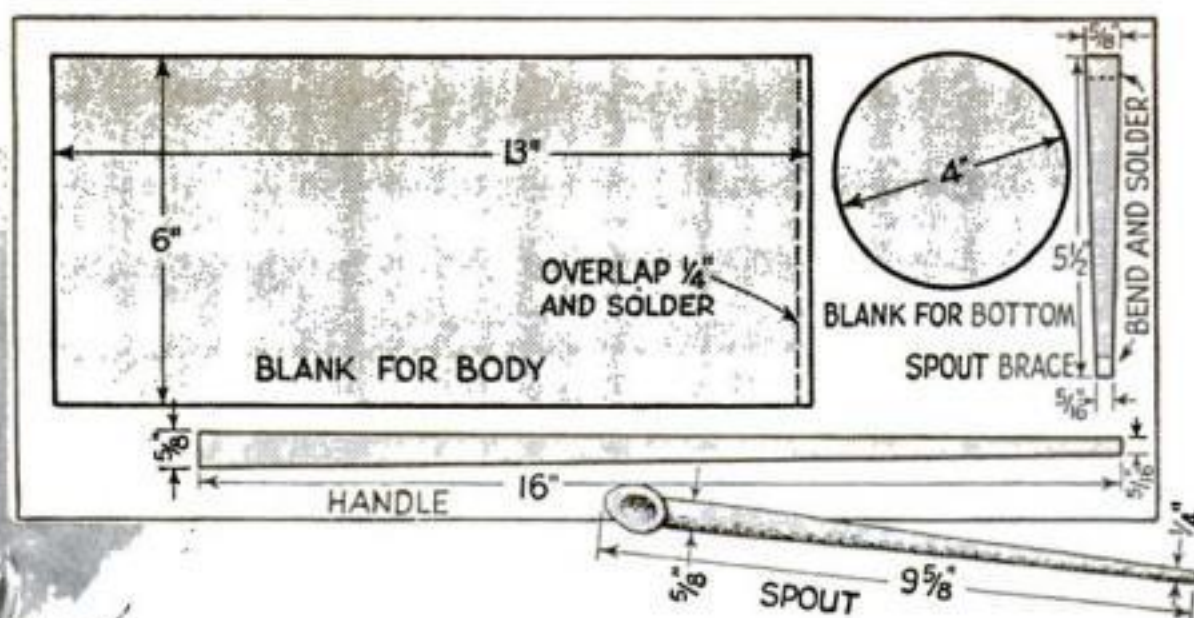
To the other pole of the battery or transformer, connect a single insulated wire and run it to one pole of a doorbell or buzzer. Another wire connects the other pole of the doorbell or buzzer with one end of the tube, where it should be soldered. Insulate about 4" of the left end of the tube by wrapping it well with friction tape. This provides a convenient space upon which the ring may be hung when not in use. Tape up 2" of the other end of the tube as well. The tube is thus left bare for exactly 30".

The backboard, which may be wood, wall board, pressed composition wood, or even heavy cardboard, is divided into ten spaces of 3" each, and numbered from one to ten. Use numbers cut from a calendar and paste them on. The auxiliary parts can be as simple or as elaborate as desired.

The scoring may be done in several ways. One is to note the number space where the bell rings, and the highest number wins. Another is to keep score up to 100.



The parts are connected in a simple bell circuit



A SIMPLE piece to make is this little polished-copper watering pot. The can itself is 20-gauge soft sheet copper. It is hammered, and the side seam is overlapped and soldered. The bottom is also soldered in.

The spout is made from a $9\frac{5}{8}$ " length of $\frac{1}{2}$ " inside-diameter copper tubing with a wall approximately 0.037" thick. Slip the tube over an iron bar and expand as much as possible by hammering, as demonstrated at the left; then, holding the tubing on the anvil, reduce the other end to $\frac{1}{4}$ " in diameter by hammering around the tube and tapering evenly toward the large end. Several annealings will be required to accomplish this. Form a flange on the large end as shown. Drill a $\frac{1}{2}$ " hole through the side of the completed can 1" from the bottom and on the opposite side from the seam, and solder the spout in place over the opening.

The spout is supported with a strip of 20-gauge copper, which is soldered in place. The handle is of 16-gauge copper. It is riveted in place, and the rivets are soldered over on the inside of the can. Polish the completed piece with brass polish applied with a cotton flannel pad. For a dull-rubbed effect, add FFF pumice stone to the polish.

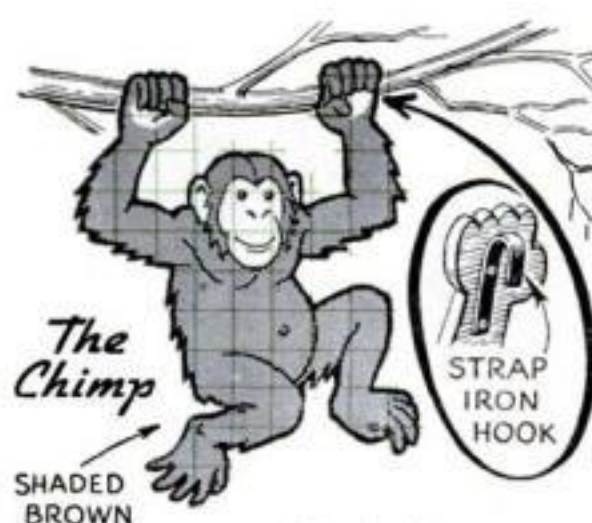
Scissors Quickly Test Defective Flash Light

THE next time your flash light fails, test the bulb and batteries by holding ordinary scissors against the base of bulb and battery as shown. If the battery lights the bulb, you know the trouble must be with the flash-light case or switch. If the lamp doesn't light, either the bulb or battery is bad, and you will have to test the lamp with a new battery.—ANTHONY WALLACE.



SCROLL-SAWED Garden Figures

A BRIGHTLY painted wooden figure or animal relieves the monotony of a wide expanse of lawn, or introduces a sprightly note among the flowers or shrubs. Any of the accompanying designs can be reproduced in sizes to suit your fancy simply by making smaller or larger squares than indicated when laying out the full-size patterns. All are scroll-sawed, preferably from $\frac{1}{2}$ " or thicker outdoor plywood, and painted in lifelike color schemes. They are held up-right by iron stakes, which are screwed to the back.



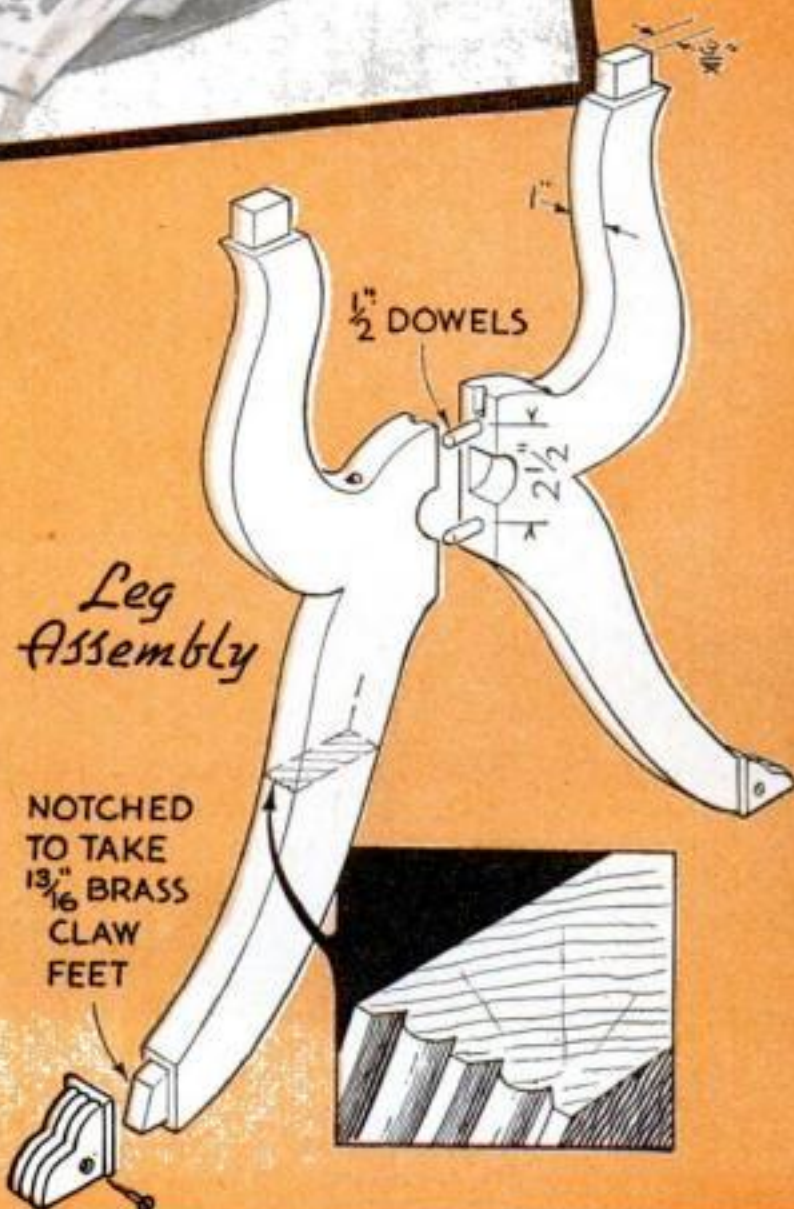
Mahogany Coffee Table



METHOD OF PLACING
PATTERN ON BOARD
FOR BAND SAWING

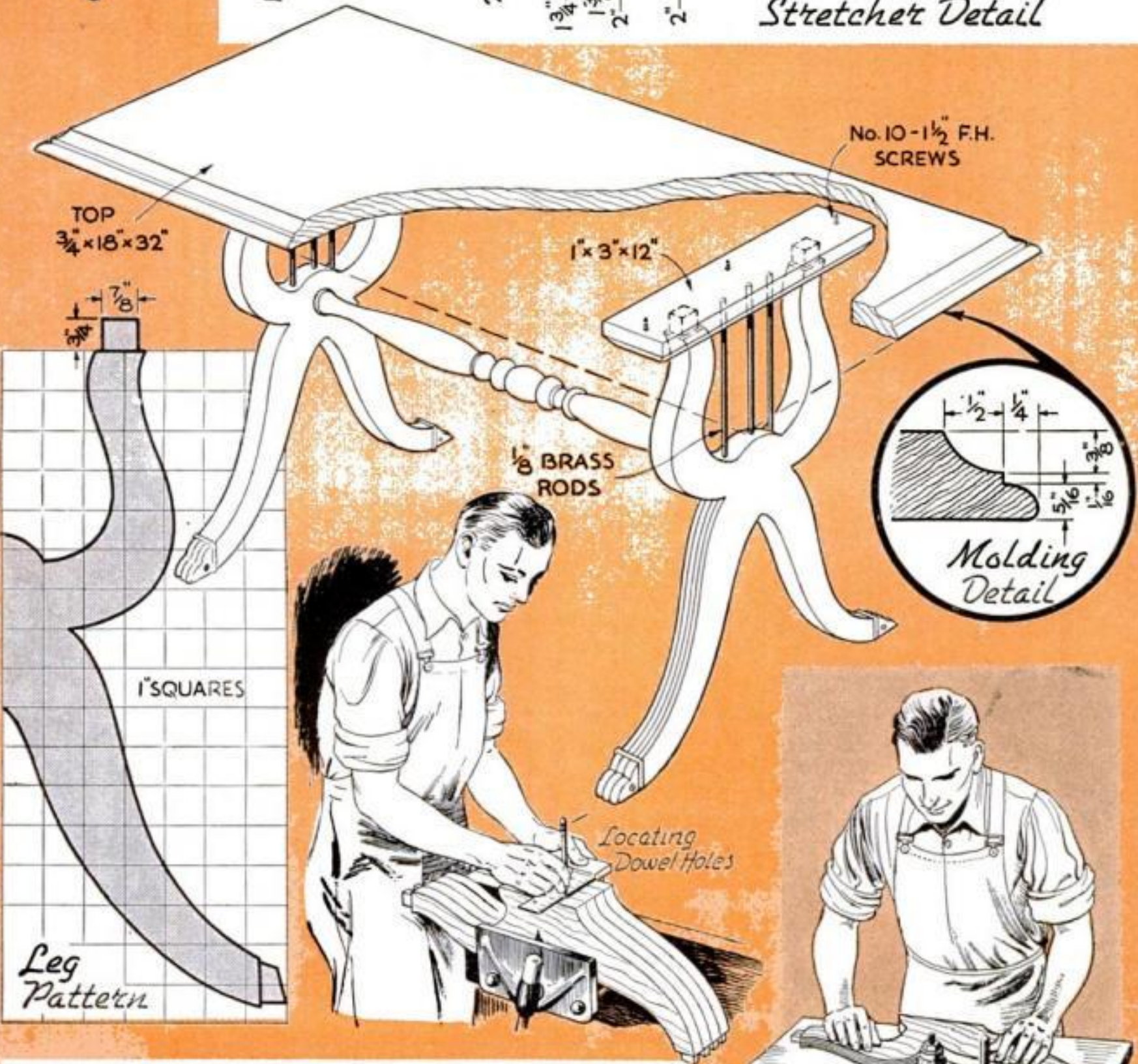
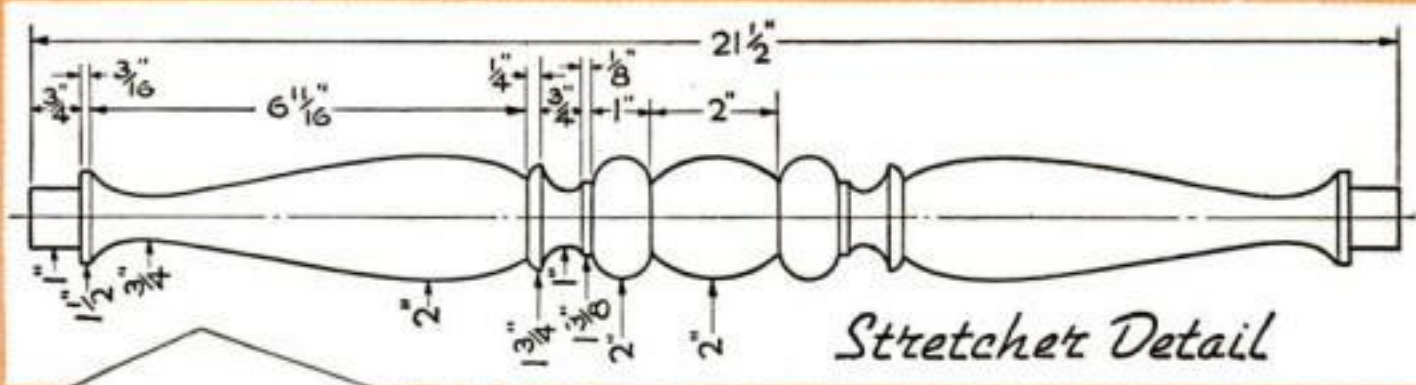
THIS coffee table may be classed as a modified Duncan Phyfe design. Mahogany is the most appropriate wood, but any good cabinet hardwood is suitable. If desired, a tray or a drawer may be added, or both. Instead of shaping the top as shown, the edges and ends may be left square and inclosed with $\frac{3}{8}$ " by 2" strips, fastened so as to retain a piece of plate glass the size of the table top.

One piece 1" (when dressed) by 6" by 66" is sufficiently large for the legs. For the stretcher, a piece $2\frac{1}{4}$ " by $2\frac{1}{4}$ " by 22" is needed. The top is made by gluing four pieces 1" by $4\frac{3}{4}$ " by 33" together.



with Lyre-Shaped Legs

DESIGNED
BY
Q. E.
MATHIS

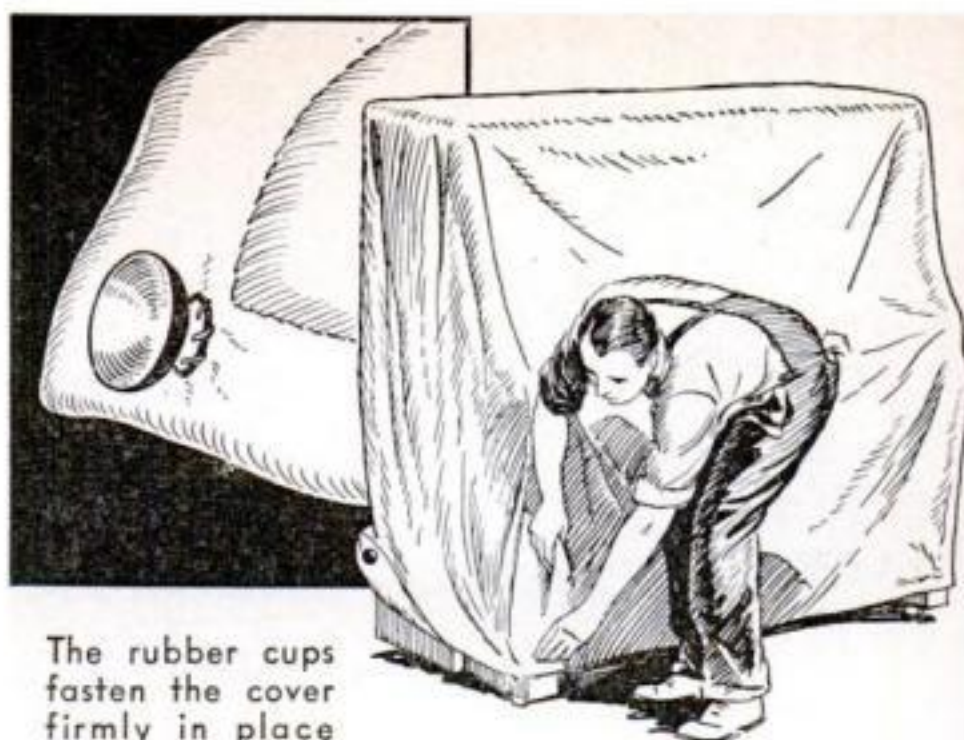


Furniture Covers Held with Vacuum Cups

INSTEAD of using ropes to hold protecting blankets on pianos and other furniture, one moving-van company has vacuum cups sewed in the corners of these coverings by means of which they may be quickly attached to any smooth surface.—E. H.

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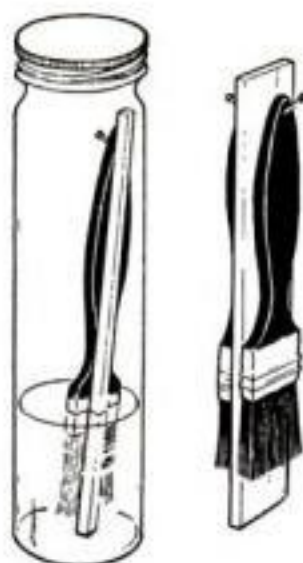
STICK shellac for filling cracks and holes in woodwork can be made by melting together equal parts of rosin and flake shellac and adding dry colors.



The rubber cups fasten the cover firmly in place

Small Brushes Kept Soft in Olive Bottles

SMALL brushes used for paint, enamel, varnish, and lacquer can be kept soft and dust-free in capped olive bottles. Cut a stick about $\frac{3}{8}$ " square and as long as can be fitted into each bottle. Drive a brad obliquely into the stick about one quarter of its length down from the top, and drill a slanting hole through the brush handle so that the brush may be hung on the stick with the bristles off the bottom. Fill the bottle with the required solvent or liquid keeper at least to the top of the brush ferrule. Four tiny brushes may be hung, one on each side of the stick, or a flat stick may be used for two relatively wide brushes.—THOMAS SUTHERLAND.

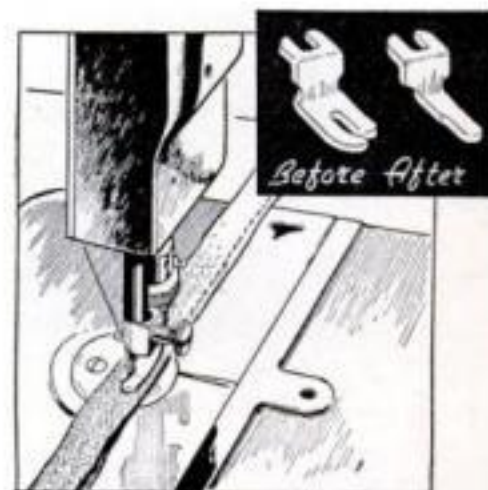


Soap Lubricates Dead Center

WHITE laundry soap is a better lubricant for the dead center of a wood-turning lathe than either oil or grease.—F. H. G.

Sewing Close to Upholstery Cords

SINCE the pressure foot on a sewing machine has two prongs, it is difficult to sew close to any cording or welting for upholstery work or to sew on slide fasteners, hook-and-eye tape, and snap tape. The pressure foot keeps the needle too far away. This can be avoided by cutting off the outside half of the pressure foot—the half that is toward the left as one faces the machine. The right half will still be sufficient to hold and feed the material. The pressure foot can be cut with a hack saw, and the rough edges removed with a file.—H. B.



How to Protect Hands Against Sticky Putty



filled with powdered whiting. This needs merely to be rolled in your hands to coat them with the protective powder.

A Bookmark That Can't Become Lost

SOME bookmarks are cumbersome, others require to be clipped on a page to keep them in place, and many are so flimsy that they are easily lost. Here is one, however, that costs nothing and has none of these disadvantages. It is merely a rubber band fastened to the binding with an ordinary paper clip.



Oil Renews Dried Ribbon of Typewriter

WHERE a typewriter ribbon dries out rather than wears out, an application of a very little light machine oil will continue it in service un-



til the pigment is exhausted or the fabric is worn out. To avoid oiling it unevenly or too heavily, clip a piece of good quality blotting paper to the ribbon guides near one spool. While the ribbon is pulled through the blotting paper, oil is applied in sufficient quantity to moisten the ribbon. Excess oil may be removed by substituting dry blotting paper after the ribbon has been oiled.—C. O. R.



Wire Coat Hanger Bent into a Roasting Spit

FOR grilling alternate slices of tomato, onion, and chunks of meat to a juicy crisp over a camp fire, there is no better spit than a wire coat hanger because the food is pierced in two places and can be turned over to brown evenly. Simply cut the hanger in the center and straighten out the wire. The paint or enamel should be burned off the spit before use.—SIGMUND SAMETH.



Scraper Added to Handle of Painter's Duster

IN PAINTING overhead in high places where one hand must be used to balance or steady oneself, only one hand is left free to reach the surfaces to be scraped and dusted. In such cases a combination duster and scraper saves many motions and much time. This painter's tool is made by riveting the blade of a heavy putty knife in the handle of a duster as shown.—JOE GOVIN.

By
EDWIN M.
LOVE

IN THE HOME



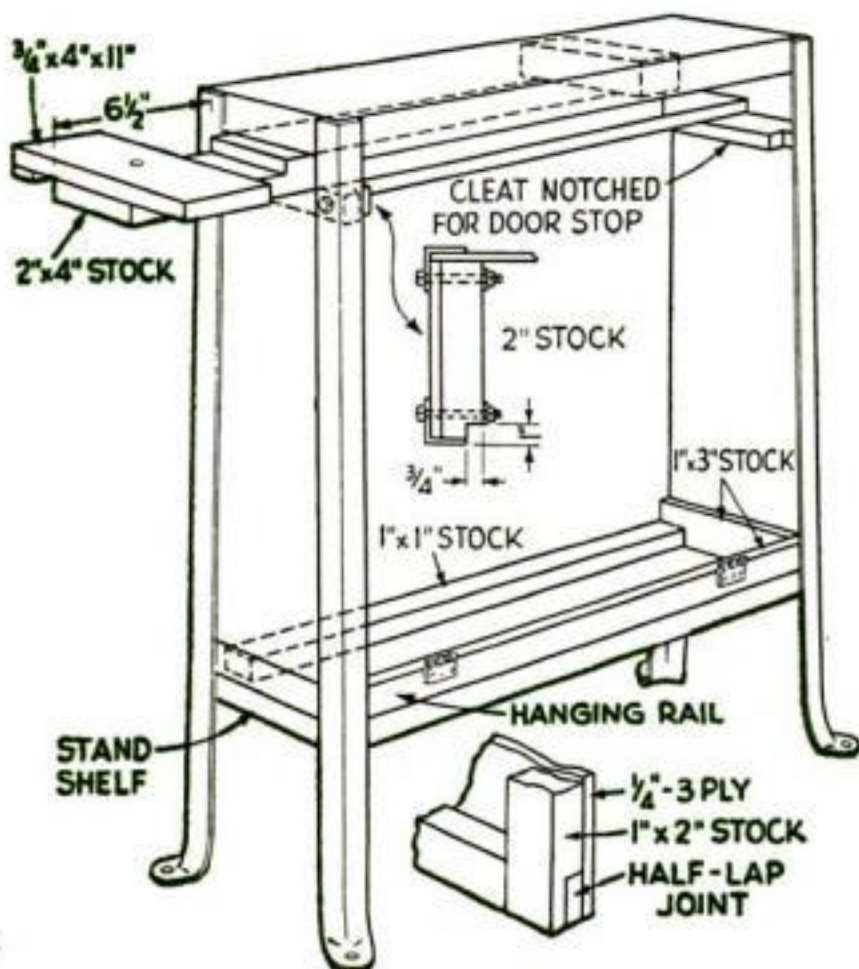
ONE question that cannot be ignored in starting a home workshop is the safety of the machines. If almost any machine is carelessly handled, it can be dangerous, but no high-grade home-workshop machine is likely to cause an accident if reasonable care is exercised. After all, one of the most hazardous devices ever invented is the family bathtub with its slippery bottom, and in spite of numerous automobile accidents, we drive our cars without hesitation. Certainly no man need do without small woodworking machines because he fears an injury may result.

Before starting to answer questions on this topic, however, we must give a report on the budget shop of Robert Jaacks. The seventh month finds him with a good selection of hand tools and three machines—an 8"

circular saw and a 4" jointer mounted on a combination stand, and a 24" scroll saw. He has discovered that the storing of wood scraps is something of a problem, and so has inclosed the scroll-saw stand to form a bin as at the left. In addition, he has made a stool that slides into the cabinet when the seat is turned parallel with the support.

To close in the stand, a piece of three-ply fir wall board was fitted between the legs on one side. It was cut short enough to slide between the front legs when inclined to the diagonal. The end pieces were then fitted, the front one being notched to pass the seat. These were forced in place to wedge in the ends of the side panel. Cleats were added at the bottom, and the hanging rail for the door was wedged into place. Few nails were therefore needed.

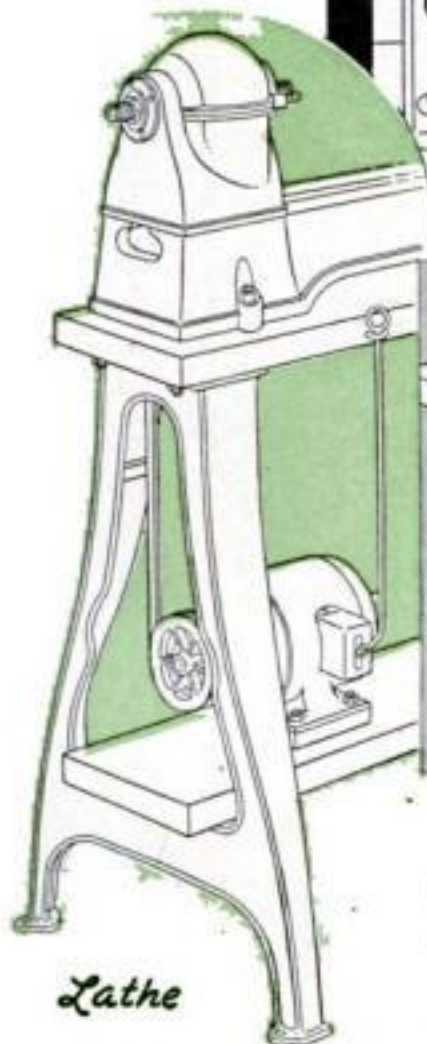
The seat is a piece of 2" by 4" notched for the crosspiece, which is pivoted with a screw or bolt. A block was nailed on top of



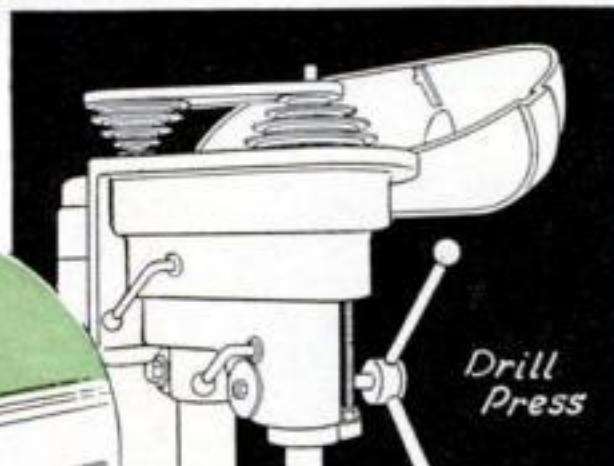
FIRST

WORKSHOP

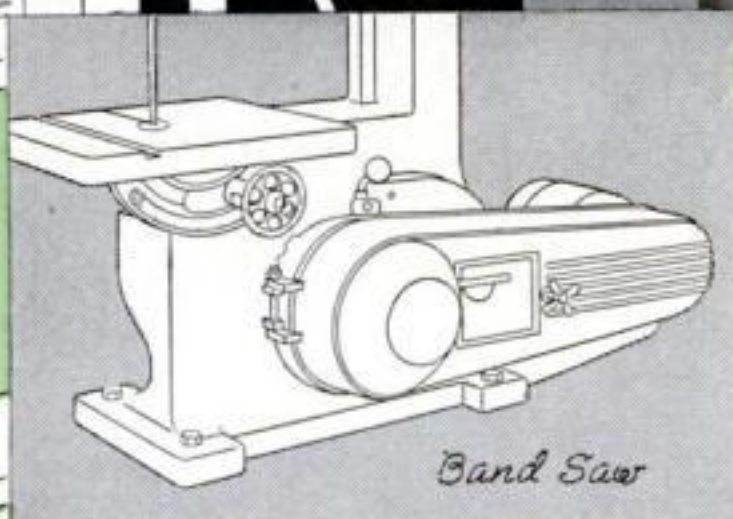
PART VII



Lathe



Drill Press



Band Saw

High-grade modern woodworking machines for the home shop are as well guarded as it is possible to make them. Here are three ways in which moving belts are kept out of the way on typical small machines

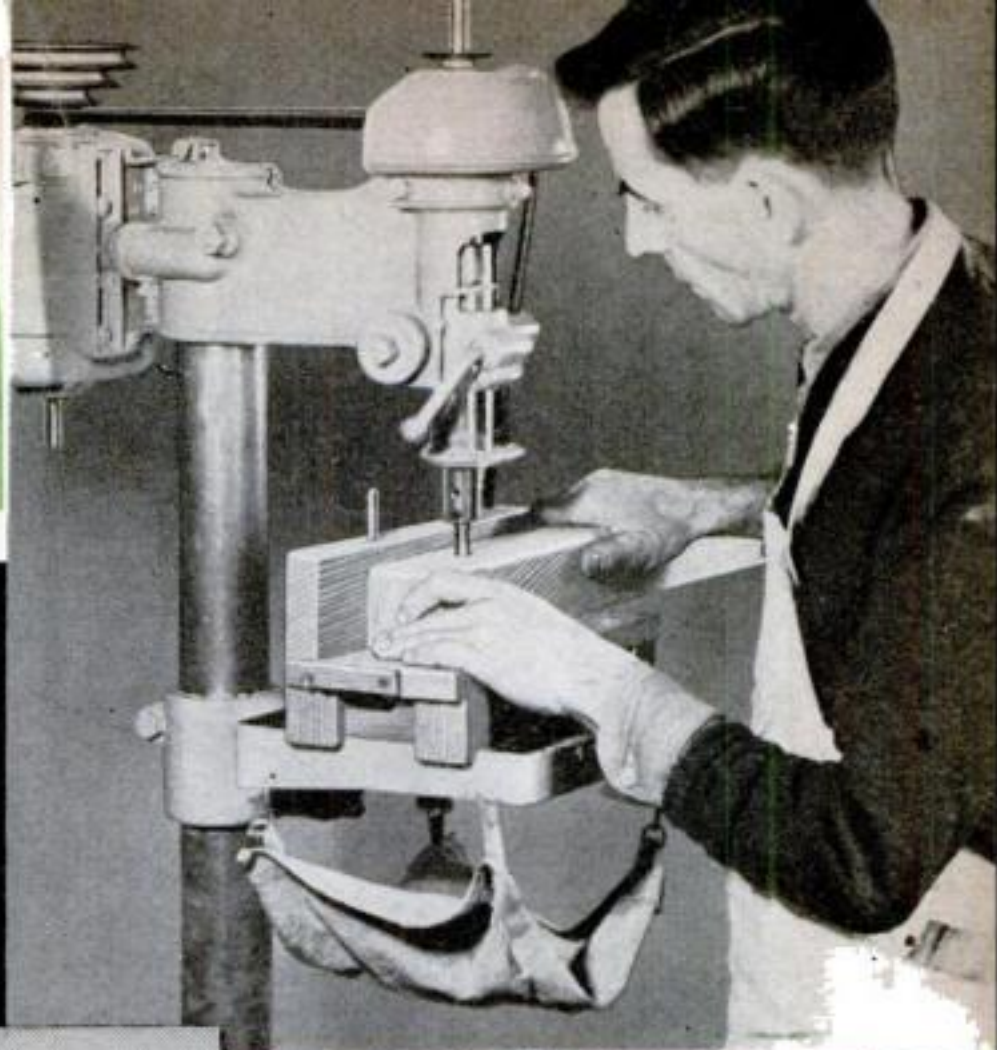
the end to slide against the stand top and between the sides; this prevents the rear end from rising in use. A cleat of 2" stock was bolted to the front legs at the bottom of the notch to carry the weight. A slat was run under the seat support, from front to back, to prevent its sagging into the bin.

A door was framed with half-lapped joints, sheathed with plywood, and hinged to the lower rail. Stops were added as necessary, and a finger hole bored in the door. A rubber-covered screw in the upper edge acts as a friction latch.

To return now to the subject of safety, the working parts of present-day machines are so well guarded that it would seem that only by deliberate intention could the operator injure himself.

What are basic rules for "safety first" in the home shop?

The number-one rule is, be careful! Tol-



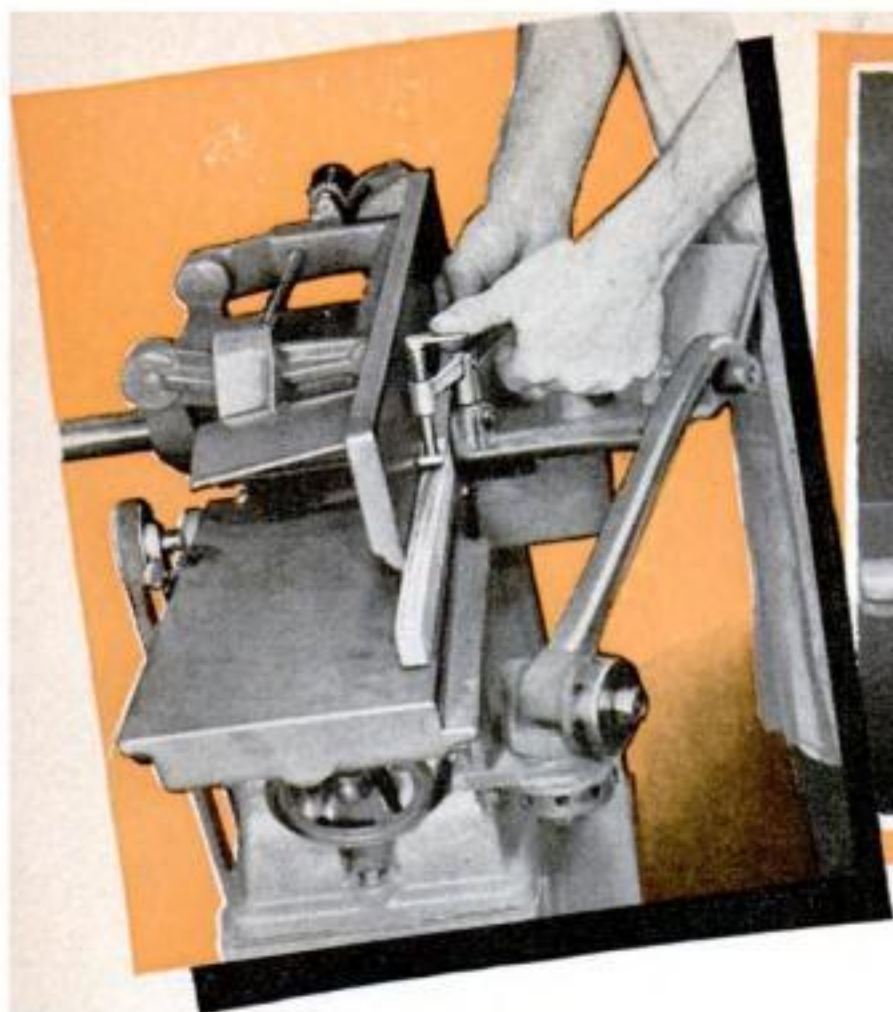
Routing a mortise with a drill press. Only light cuts should be taken. The stock is guided against a rigidly clamped fence

erate no loose sleeves or dangling neckties. Just as a wise person looks to right and left before crossing a busy street, the wise shopman inspects his set-ups, examines grinding wheels for cracks, and makes sure that everything is clear before starting any machine. Wear goggles when grinding. Operate starting switches your-

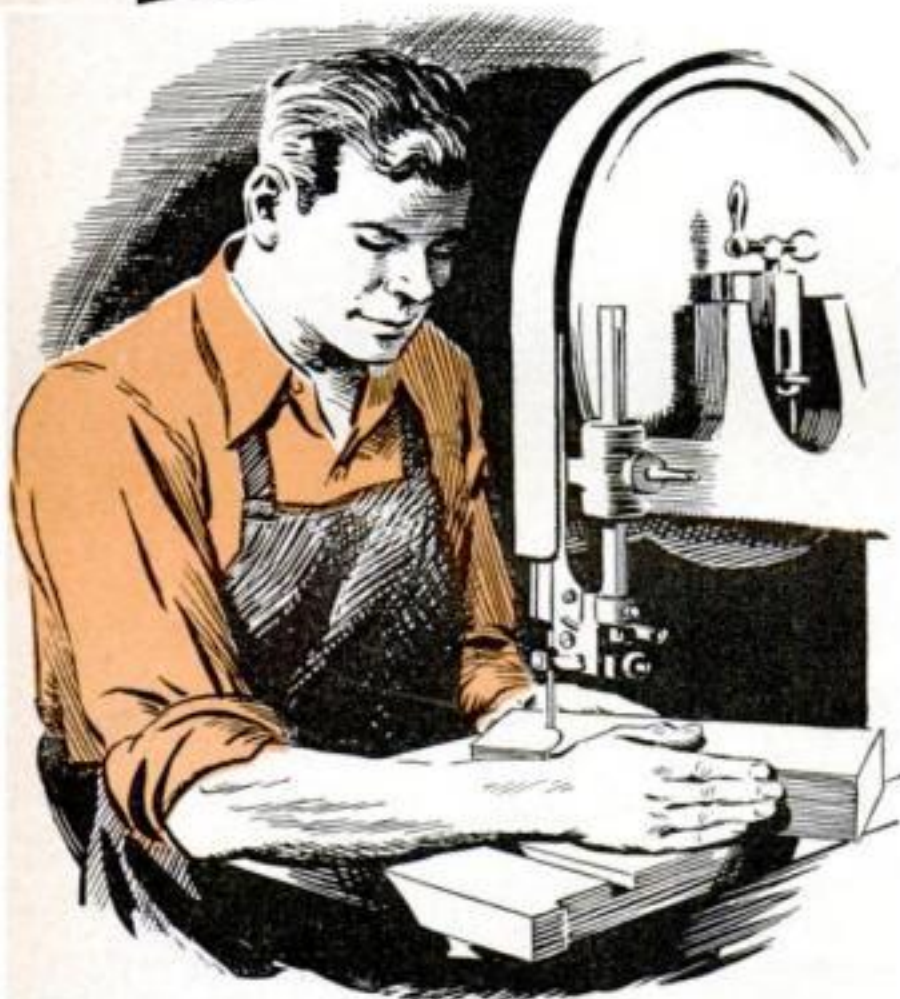
self unless special circumstances require a helper. Make no adjustments and never shift a V-belt while the machine is running. Keep your mind on your work, don't talk to anyone while operating a machine, and don't let anyone talk to you.

What special safety rules apply to the circular saw?

Use the guards. In general, allow only enough of the blade above the table to cut the thickness of the material. When ripping, stand to the side so that the board, if thrown by the saw, will fly past. Always guide the work with a fence in ripping unless the lumber is too wide, or if an irregular line must be cut, as when a board is scribed to fit edgewise against a plastered wall. Use a push stick with narrow or short pieces of wood; and when cutting tenons, or in other work where the blade must be approached with the fingers, hook them over the fence



Left, a jointer attachment for planing narrow strips. A small shoe forces the work against the cutters. Above, using a jointer push stick



To operate a band saw with the guide so high is dangerous. It should be about $\frac{1}{2}$ " above the work

and slide along it while pushing the work forward. Then your hand won't slip.

How is a jointer safely used?

For ordinary jointing, be sure that the rear table aligns with the knives at the top of their travel. While the cutter head is equipped with a safety cylinder, which prevents careless fingers from dropping deeply between the knives, take no chances, but use the guard. Unless special devices are used, do not joint material narrower than 1" wide, or shorter than 12". End-grain jointing, except on wide stock, should not be attempted.

Are scroll saws guarded?

Yes. By means of a forked hold-down, a projecting blade guide, or a stiff rod bent into a ring surrounding these parts. This saw is naturally a safe machine.

How is a wood-turning lathe guarded?

Beyond inclosing belts and pulleys, little guarding is possible, but the lathe is a safe machine. Examine the wood for checks, loose knots, or any other defect which might allow fragments to be thrown off. Rough-turn at low speed with the tool holder as close to the work as possible, and hold the tool with both hands. When sanding, remove the tool rest to give ample clearance for the hands. Be sure that faceplate work is solidly screwed on, and keep down the speed with large work.

What safety precautions are taken with the drill press?

Hold the work as firmly as possible. If an ordinary auger bit is adapted for use in the drill press, keep to slow speed because any irregular running may bend the shank at right angles, with the bit thrashing around like a spoke in a broken wheel. Avoid deep cuts with router bits, and lock the quill.

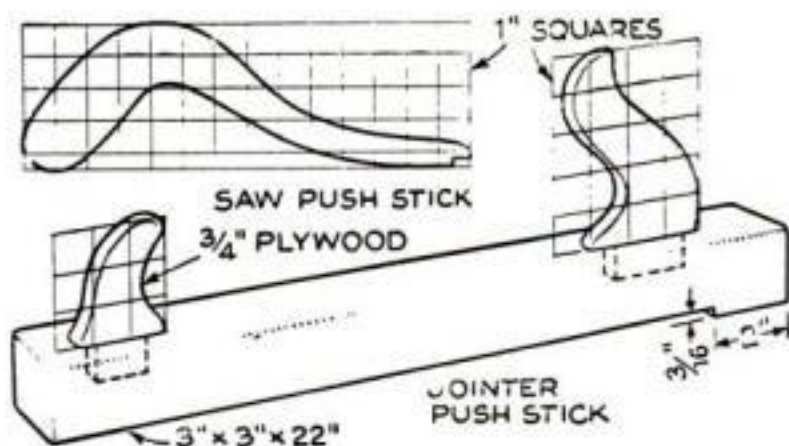
Are there any special safety rules for operating a band saw?

See that the guides are accurately adjusted, with the blade tracking properly on the wheels. The teeth must move downward, drawing the work against the table. Have the upper guide not more than $\frac{1}{2}$ " above the work, as the guide marks the lower end of the blade guard. Avoid standing to the

PUSH STICKS

[WOODWORKING]

Push sticks for circular saws can be made by sketching the pattern through 1" squares and transferring to $\frac{3}{8}$ " plywood. Saw out and round off all corners except at the notch. If there



POPULAR SCIENCE MONTHLY SHOP DATA FILE

is no splitter on the saw, make a second stick of $\frac{3}{4}$ " plywood to press small pieces against the ripping fence. A push stick is invaluable for ripping small pieces of wood.

A push jig for the jointer is made by squaring up a piece of 3" stock and rounding the upper corners. Saw out handles as shown, preferably from $\frac{3}{4}$ " plywood, with tenons, and mortise into the stock near the ends. Set the jointer for $\frac{3}{16}$ " depth and trim the bottom to within 2" of the rear end. Finish the notch square by hand. Short or thin pieces to be planed are held rigidly by the jig.

right of the machine, especially if it is not well guarded, for a broken blade sometimes whips out and cuts viciously.

How can machines be guarded against children?

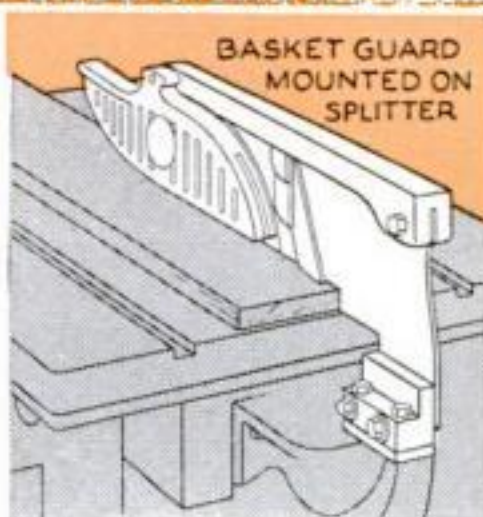
A master switch that can be locked, and red lights burning to indicate that power is on, are desirable. Safety wiring will be discussed in a later installment. Keep the floor clear of blocks, shavings, power cables, and the like. However, children are not in the danger that many people imagine. The writer's two boys invaded his shop at a tender age and have operated the scroll saw since they were five years old, progressing to the sanding disk and drill press within a couple of years. A few small scratches constitute the casualties.

Next month Mr. Love will discuss shapers, sanders, and other woodworking machines.

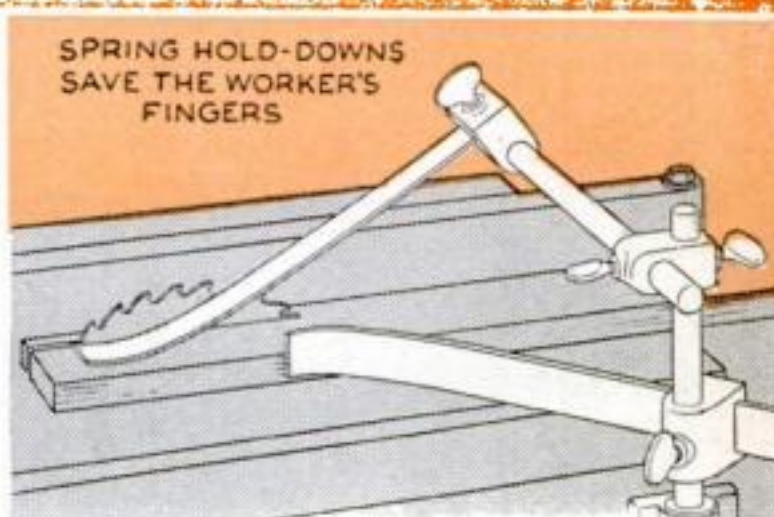
Push sticks are used for ripping a small board. If a splitter is available, the side push stick is not needed. Here the blade is inclosed by a basket guard. The adjacent jointer also is guarded.



HEAVY CAST-IRON GUARD USED WITH ABRASIVE DISK



BASKET GUARD MOUNTED ON SPLITTER



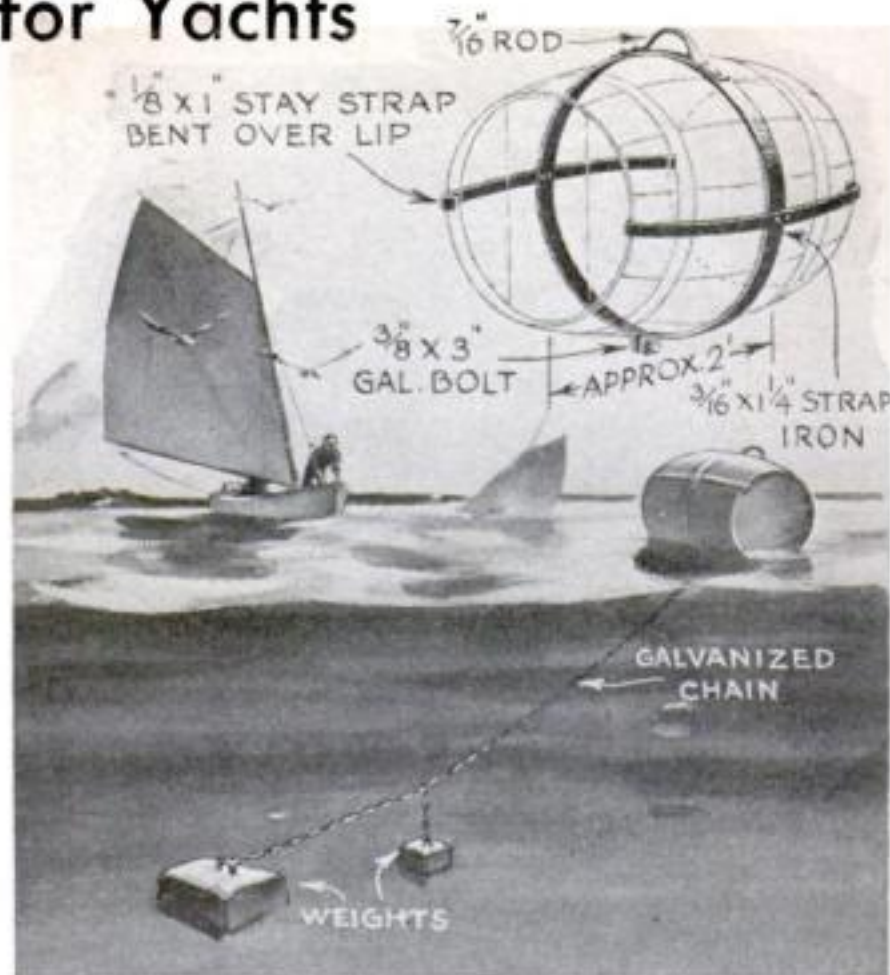
SPRING HOLD-DOWNS SAVE THE WORKER'S FINGERS

Low-Cost Mooring Buoys for Yachts

A PRACTICAL, inexpensive mooring buoy can be made by fastening iron straps to a wooden keg such as is used for popular brands of soda-fountain beverages. These "empties" can be purchased at many drug stores for from 50 to 75 cents.

Fit a softwood plug in the bunghole and give the keg one coat of aluminum paint. The drawing shows how to fit the iron strap at the center and the two stay straps. Use a mooring hook spliced to the end of the mooring line for quick attachment.

Scrap iron such as furnace grates may be used in lieu of a regular mushroom, trawl, or Navy anchor. Two weights used on the anchor chain are less apt to drag than a single weight. Give the mooring buoy two additional coats of aluminum paint when it is completed.—A. M. YOUNGQUIST.



Auto Mirror Aids Rower

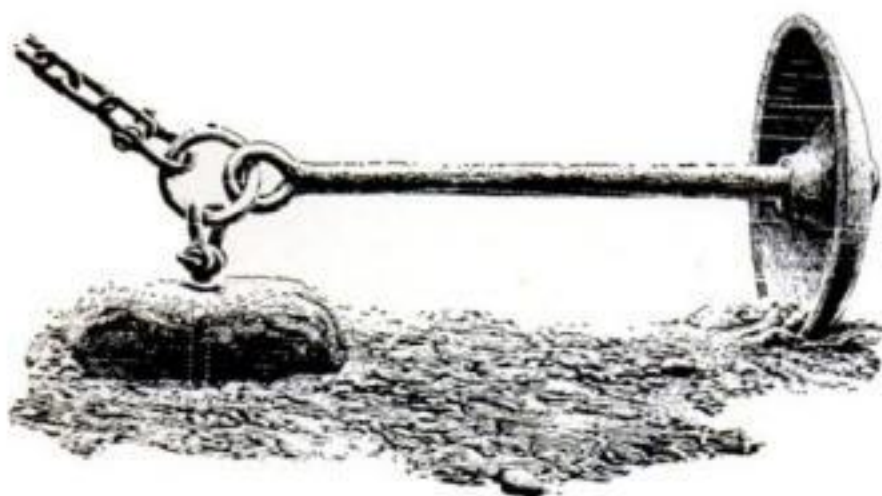
WHEN rowing a boat, it is tiresome to have to turn one's head repeatedly in order to keep a straight course and dodge other boats or partly submerged logs and obstructions. If a rear-view auto mirror is fastened to the stern of the boat as shown below, it will be found a great help.—DARRELL ATKIN.



Paper Plates Tacked to Table

PAPER plates can easily be kept from being blown off the picnic table or accidentally overturned. Simply force thumb tacks through the centers and into the wood.

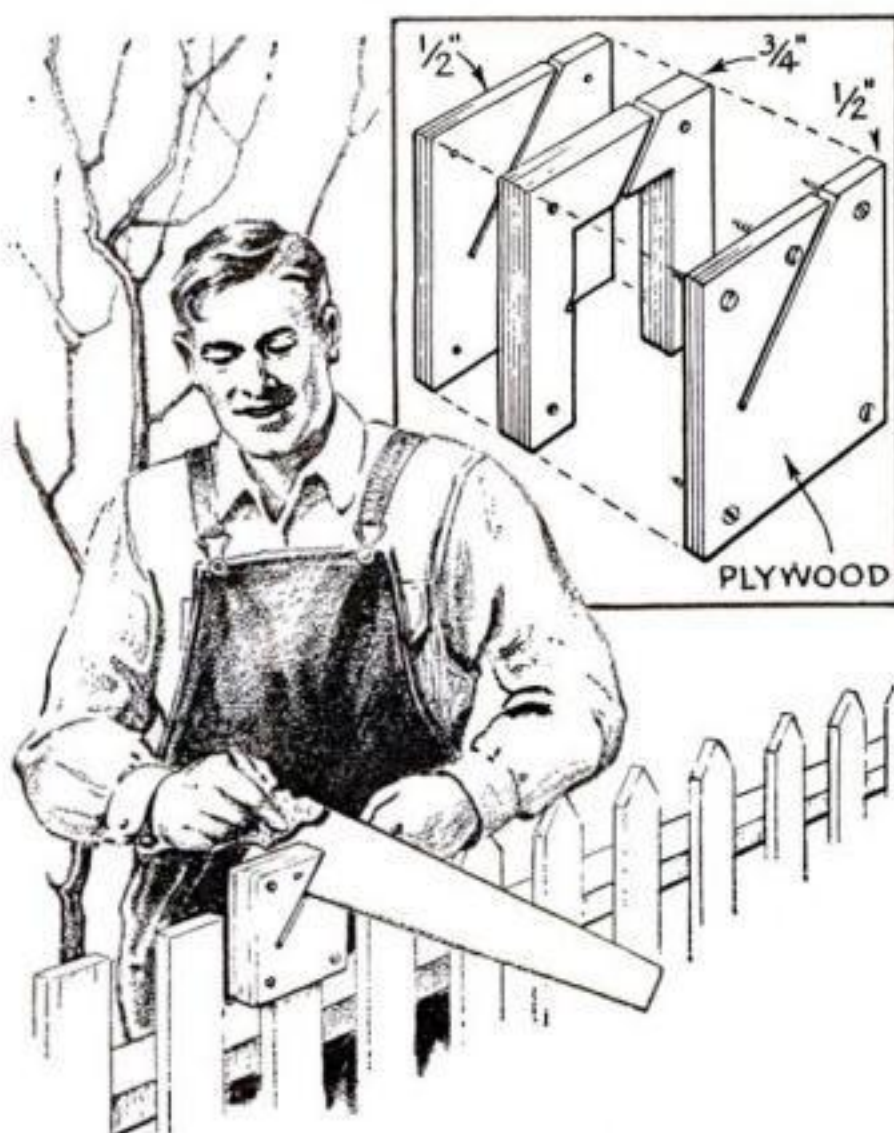
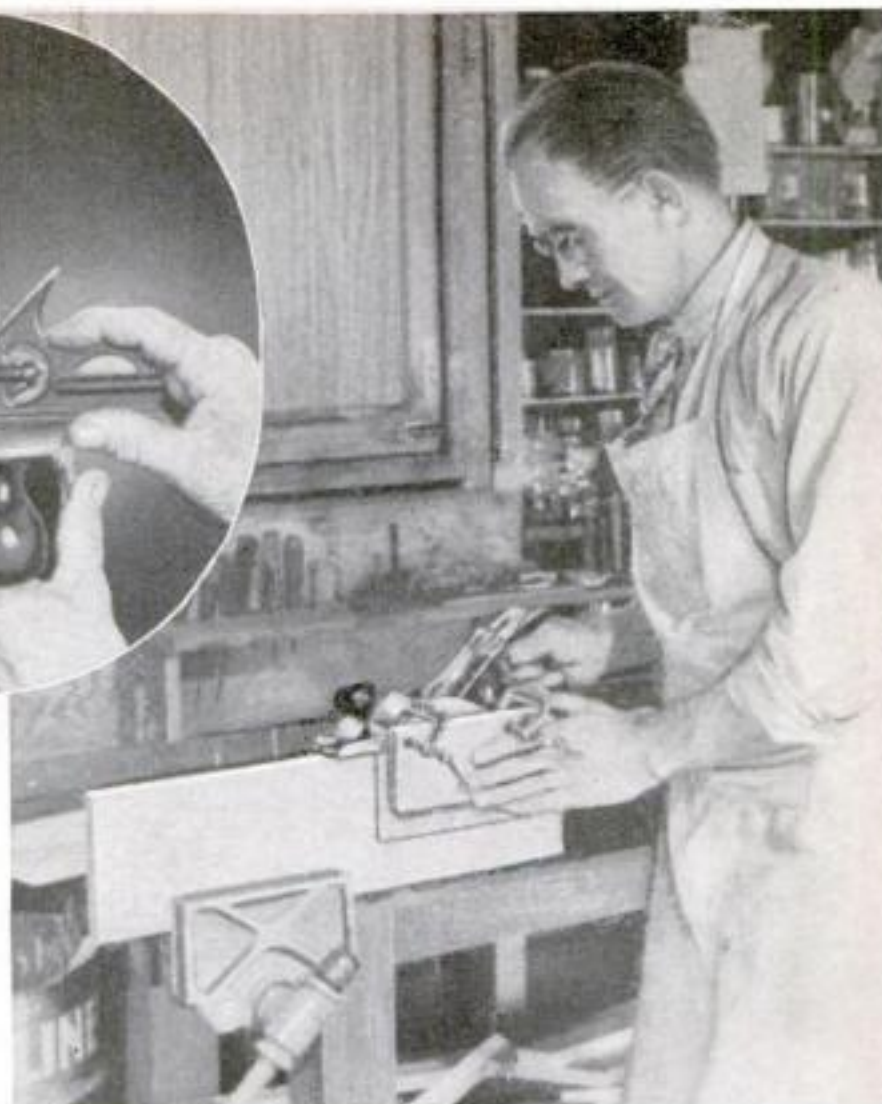
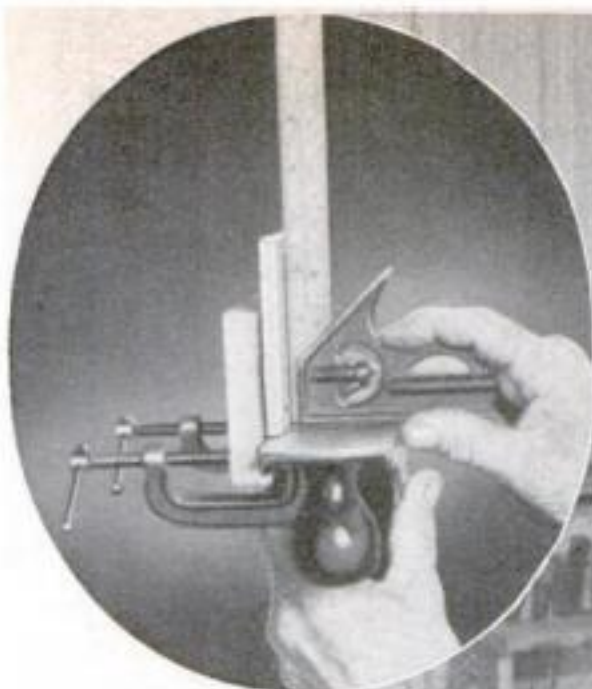
Giving Mushroom Anchors Extra Holding Power



IF THE strain on a mushroom mooring anchor proves too much, its holding power can be greatly increased by attaching a weight to the ring on the shank as shown at the left. A 50-lb. rock, drilled and fitted with an eyebolt, then shackled to the ring of a 100-lb. anchor, will more than double the holding power. When hauled ashore and the rock detached, the two elements are much easier to handle than a heavy anchor would be.—W. H. F.

Planing Guide Insures True Edge on Board

PERFECTLY square edges for making glued joints and other purposes can be obtained even by the beginner in woodworking if a planing jig is made as shown. A piece of $\frac{1}{4}$ " by $3\frac{3}{4}$ " by 8" plywood is glued and nailed 1" below the top edge of a piece of $\frac{3}{4}$ " by $3\frac{1}{4}$ " by 7" pine, which in turn is fastened to the plane with two 2" C-clamps. The blade must be trued to a 90-deg. angle with the fence, as demonstrated in the photograph in the oval. The other picture shows a board being planed or jointed with the jig attached. Pressure should be against the left side of the board being planed.—F. H.

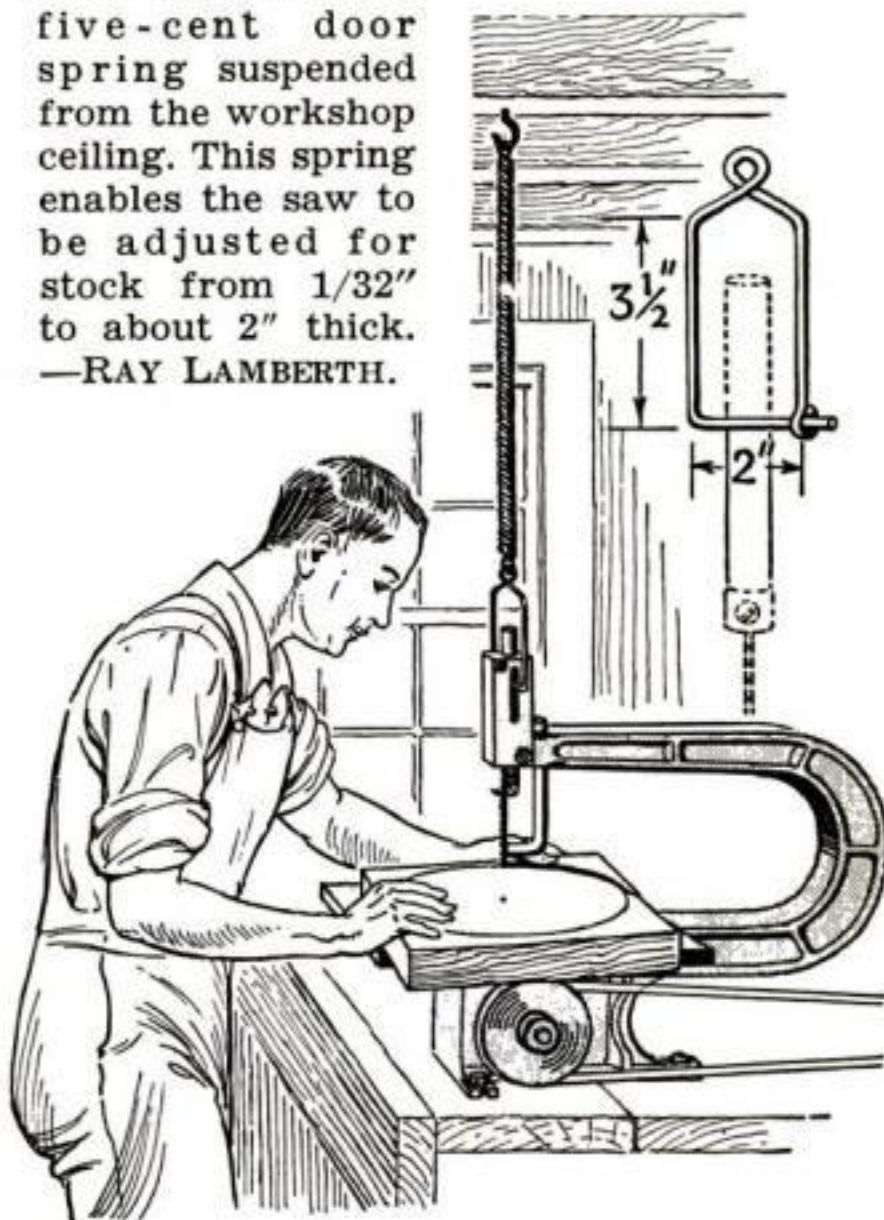


Simple Jig for Sawing Fence-Picket Points

NOT having a power saw for quickly pointing the pickets of a fence, I did the job after the pickets were nailed in place by using a simple plywood jig. It was made to slip easily over the end of each picket and provided with a 45-deg. saw cut to guide a handsaw. The jig was turned about to complete the point.—ROBERT CLARK.

Long Spring Strengthens Overworked Jig Saw

IN A COMMUNITY center where I am an instructor, the lone jig saw has to stand hard usage. The small spring which provides the necessary tension for the blade frequently broke and had to be replaced until I substituted a five-cent door spring suspended from the workshop ceiling. This spring enables the saw to be adjusted for stock from $\frac{1}{32}$ " to about 2" thick.—RAY LAMBERTH.

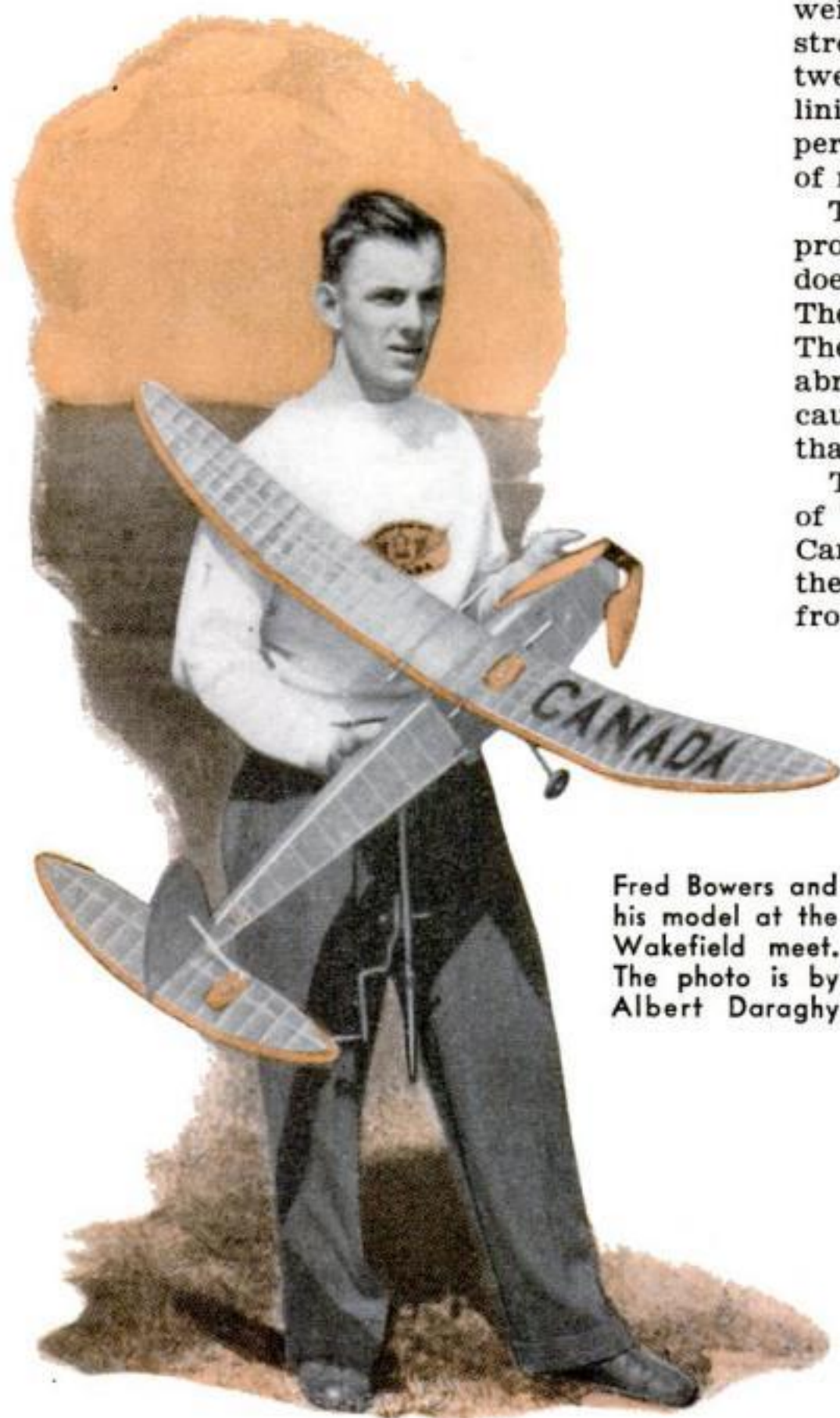


International Contest Flyer

How to build a simple but highly efficient model plane with a folding propeller and all the latest improvements to give long flights

By **FRANK ZAIC**

EDITOR OF "MODEL AERONAUTICS YEAR BOOK"



Fred Bowers and his model at the Wakefield meet. The photo is by Albert Daraghy

THE modern sail plane is the closest approach to aerodynamical perfection. Its slim fuselage and long, narrow wing reduce drag to a minimum so that it can glide for thirty miles from a height of one mile without aid from thermals.

Model builders try to achieve similar perfection because most of a model's duration lies in the glide. However, we have to contend with propeller, landing gear, minimum cross section area of the fuselage, and weight as required by competition rules. Then, too, we have to get the model high enough so that it can hunt for thermals. This means more power, which is dead weight after the turns are used up. Since streamlining adds weight, we are torn between two issues: High power or streamlining. Both can be had, but it requires expert craftsmanship and thorough knowledge of model aerodynamics.

The model illustrated is an excellent compromise. Streamlining is used wherever it does not add weight. The propeller folds. The landing gear is short and made of wire. The fuselage has a good outline without abrupt angles. It is also set on edge because it has less resistance in a side slip than when set square.

The model was designed by Fred Bowers, of Toronto, Canada, a member of the 1939 Canadian Wakefield team. He tells us that the model behaved exceptionally well right from the start. A day before the Canadian team left for New York, he almost lost it when it soared for about seven minutes on light winds. The best recommendation for the model, however, is its performances in the 1939 Wakefield competition at Bendix, N. J. On its first flight it made 13 min., 32.5 sec. An unfortunate take-off on the second trial put it out of running for the rest of the meet. Nevertheless, the first flight and a few seconds added in the second trial gave Bowers an average of 4 min., 32.66 sec. for three flights. This time was enough to place him second with a margin of a full minute above the time of the third runner-up.

Fuselage. This is made by building two sides to the given dimensions. While cutting the uprights, be sure to make four of each to assure uniformity on all sides. Note how the landing-gear wire is sandwiched between balsa sheets and how the portion that car-



Here Bowers is winding the model, marked "Canada," at the 1939 international contest

ries the removable rubber-holding peg is reinforced. The fuselage is built full length and the tail portion cut off afterwards. Be generous with cement and let it dry well before removing sides from the pin jigs.

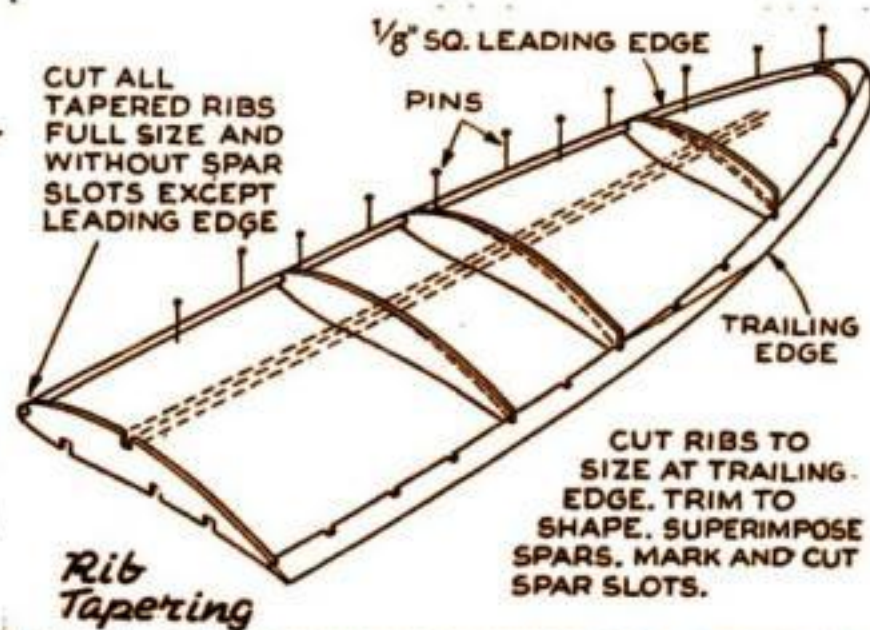
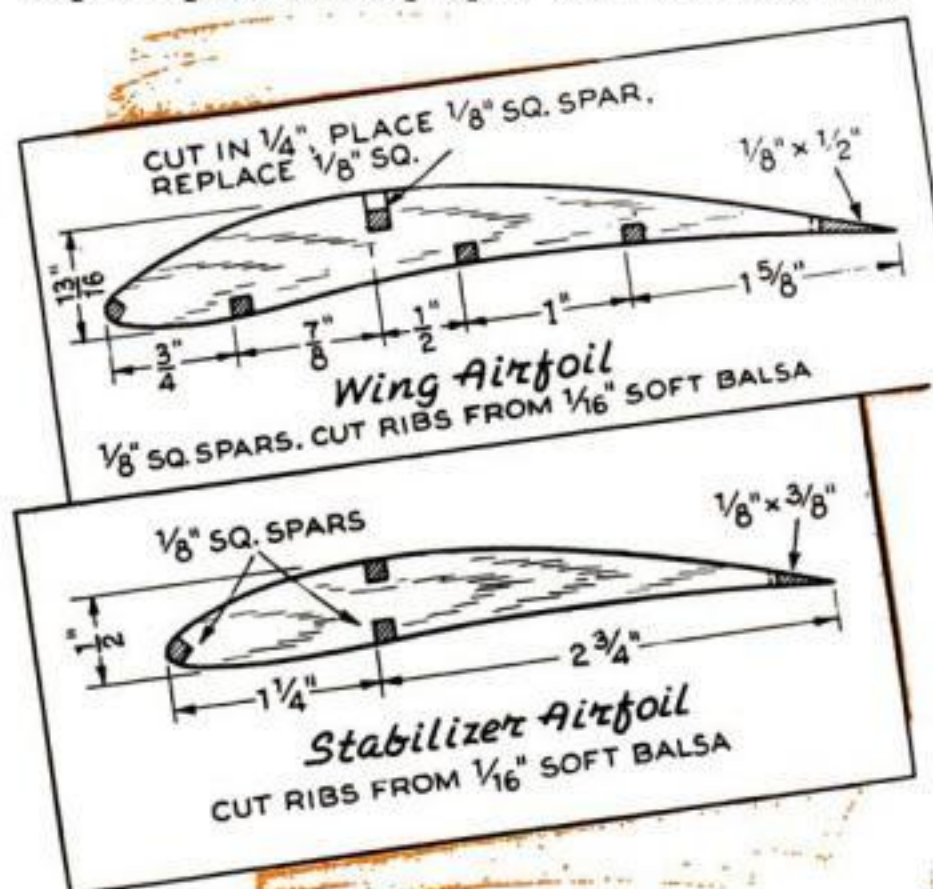
Wing. Cut the required number of ribs, but slot only 28 for spars. The other 20 ribs are slotted later on, but they do have the front 90-deg. spar cut-out. The center two sections are not tapered. To make the tapered tips, plot the outline, cut curved trailing edges from sheet balsa, and bend the leading-edge spar to the outline with a pin jig. Now fit the ribs to the space determined by the leading and trailing edges. A sketch shows how the ribs are shaped to smaller sizes. When all the ribs are in place, superimpose the top spar over the ribs and

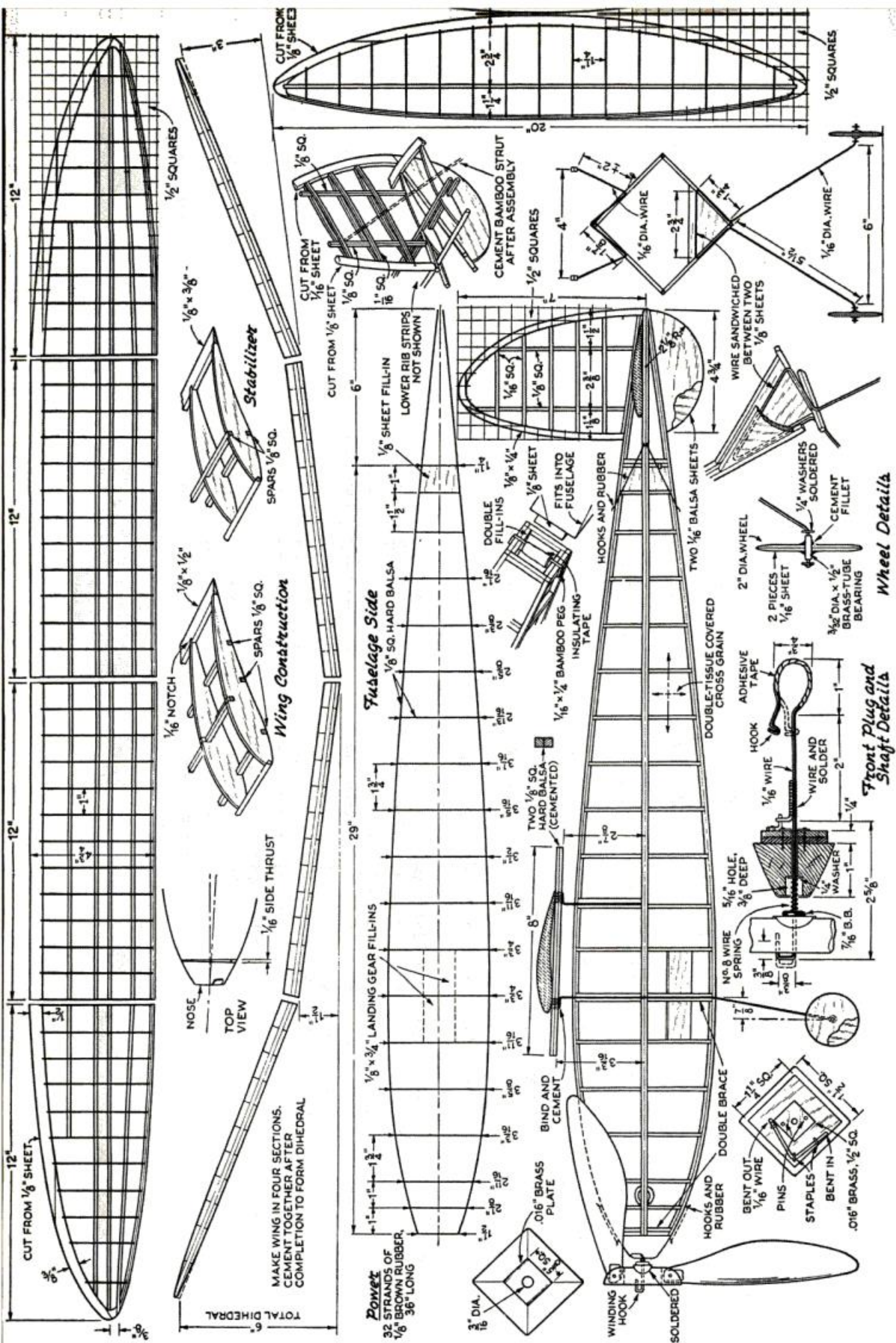
mark where it touches the ribs. Cut in $\frac{1}{4}$ ", cement the spar in place, and replace a portion of the cut-in with the removed balsa to provide a smooth and continuous rib surface for paper covering. Before removing the tip from the jig, wet the leading edge spar so that it will hold its shape more readily. The tip is completed by slotting the bottom portion of the ribs to accommodate the various spars.

Tail surfaces. The stabilizer is made like the wing tips. The rudder is equally simple. Cut the outline from sheet balsa, cement two spars in place, and cement the small square strips to form a streamline airfoil. You may have to hold the two spars temporarily in place with balsa strips while the cement dries on the rib-forming strips.

Propeller. This is carved from the outlined blank. When carving, leave the cen-

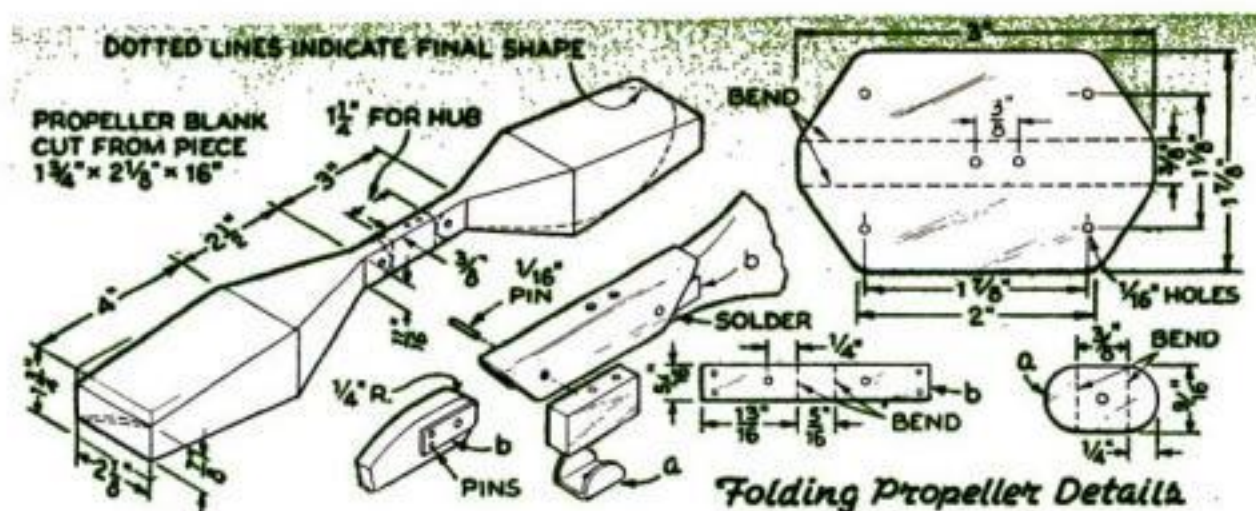
Layouts for the wing and stabilizer ribs, and sketch showing method of assembling the wing





Wheel Details

Front Plug and Shaft Details



How the propeller block is cut out and shaped, patterns for the metal parts of the hinge, and a sketch of the members ready to be assembled

ter portion with square corners. Be sure to give the blades an airfoil shape, smooth surfaces, and a coating of four applications of thinned cement. Cut the metal hub to dimensions. Drill the shaft holes, and drill hinge holes on one side only. Bend in a vise by creasing both bends a little at a time. When you can no longer bend in this way, finish with square-nosed pliers. Now you can drill hinge holes in the other half, using the already drilled holes as templates.

Cut the propeller apart as shown. The center part is used as a filler for the metal assembly. The blade ends are curved and reinforced with strips of metal. Here again you should drill the hinge holes after fitting the propeller ends into the metal hubs. When the blades fold back freely, solder the hinge pins in place. Also solder a plate on the inside portion of the hub to provide a flat surface for the ball-bearing washer.

The propeller assembly is completed by making the nose plug and shaft. Note how the spring is made to force the shaft outward after the rubber has almost unwound. This outward motion engages the L-shaped wire with the wire stop. The rubber is now prevented from further unwinding so that it will have enough winds left to hold it taut and keep the center of gravity fixed. Also, the propeller blades are stopped so that they fold in a vertical position. Air pressure folds and holds them against the fuselage.

You can use a single-blade folder if you wish. Just substitute a counterweight for one blade; a 3" length of wire on the outer end of which a solder weight is fixed will serve the purpose.

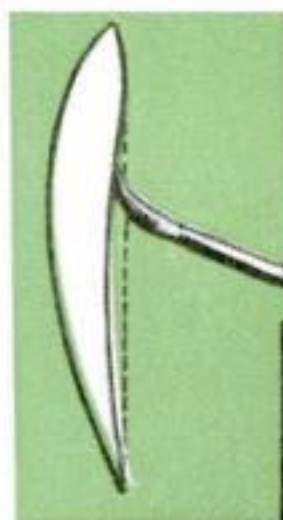
Covering. Red is a good color to use since it gives excellent visibility. A red fuselage and tail and yellow wing and stabilizer also form an effective combination to

sight in the distance. Note the use of double covering on the fuselage. It adds tremendous strength with but little additional weight.

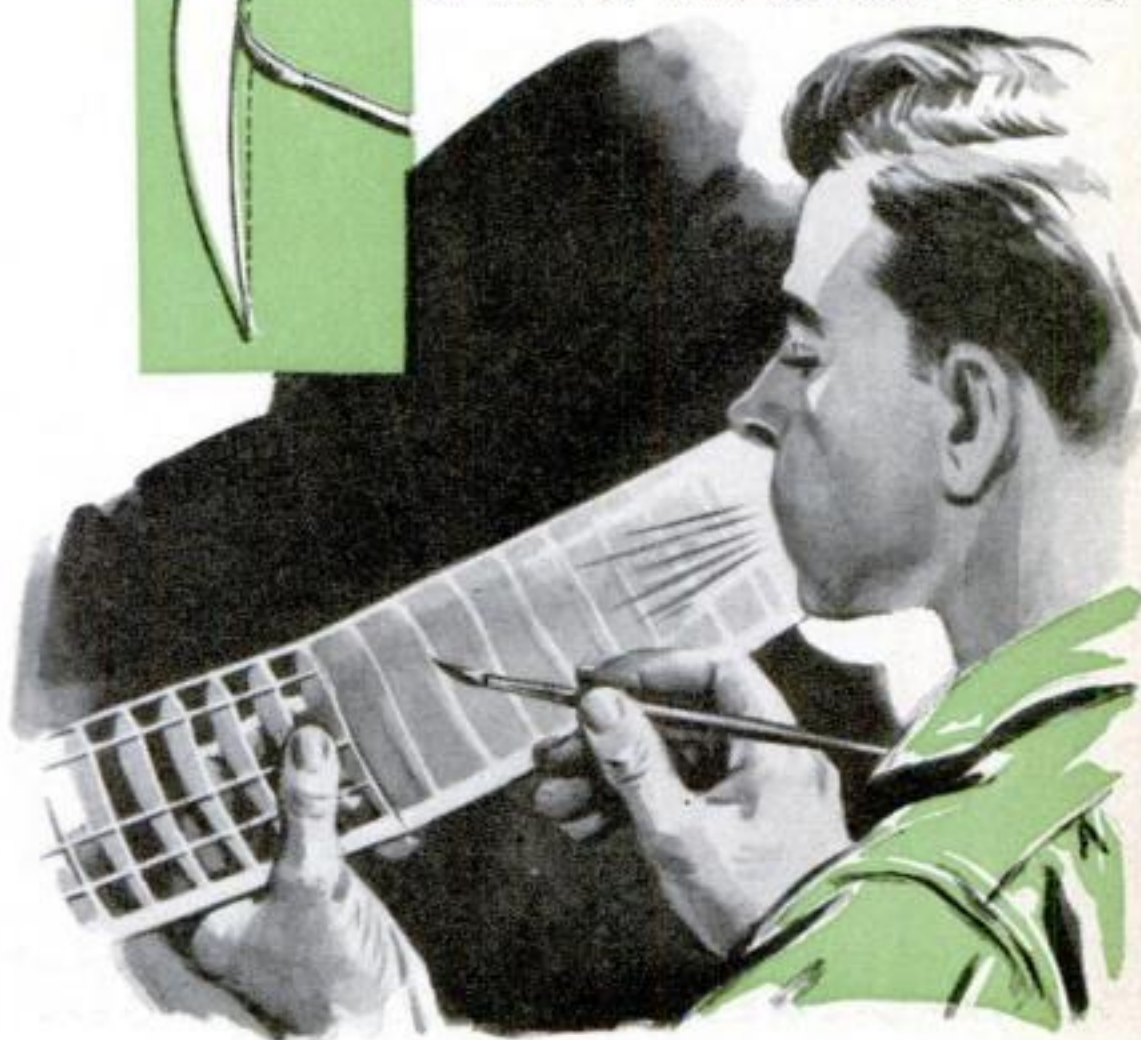
The wings are covered in sections. Cut the paper so that the grain runs spanwise with enough surplus for the overlap. Using dope for adhesive, spot the paper on the middle of the center rib. When the paper is securely held,

coat the outside rib from leading to trailing edge. Pull the paper so that it is drawn into a smooth triangle formed by the spot on the center rib and the full chord of the outside rib. Now lift up the edges and coat the leading and trailing edges with dope. Pull the paper over them so that a smooth surface is obtained. Use the same procedure on the remaining panels, top and bottom, and also on the tail surfaces. For under-camber covering, cover as described and cement the paper to the ribs by applying dope through the paper until it penetrates.

Assembly. Cut away the paper on the upper rear portion so that the stabilizer may be cemented on the top of the center longerons. The rudder is butt-jointed to the upper longeron and the stabilizer rib. Be sure to be generous with cement, and check up for true line-up. Recover the spot. Cement a



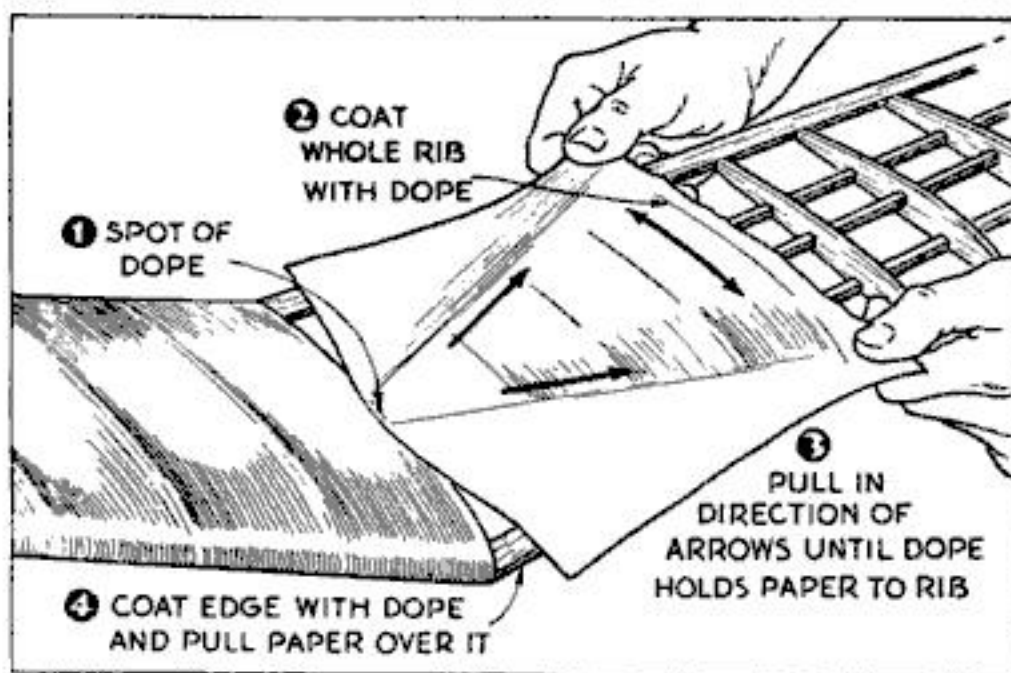
Covering the wings. After applying the dope, blow against the paper to hold it on the ribs while the dope is setting



bamboo strut to hold the rudder and stabilizer in perpendicular relation. Also cut the shape of the lower fin from light balsa sheet. Before testing, make and cement wire hooks for the rudder bands that hold the ends tightly against the fuselage.

Flying. Make the motor and lubricate with a mixture of two parts of green soap and one part of glycerin. Thread it through the fuselage and hold it anchored at the rear with the bamboo peg. Note how the peg and prop shaft are wound with friction tape to prevent rubber chafing. Also insert a 1/16" hard balsa spacer between the plug and fuselage by the center longeron for right thrust.

You should glide the model before attempting power flights. If it dives, move the wing forward; if it stalls, move it back. Now put in about 100 turns and launch it gently. The model should keep an even altitude. Make adjustments with the wing if found necessary. Wind to about 200 turns and watch its behavior on turns. It should



Starting to apply a section of the wing covering. Next the paper is cemented to the leading and trailing edges

be turning slightly to the right. Do not, however, make any turn adjustments until you have wound it to 300 or 400 turns as the torque might make up the difference.

On 400 turns the model should be pretty snappy. It should have a natural right circle, both in climb and glide. If it is too sharp under power, remove a bit of side-thrust spacing until the turn is under control. If it fails to turn in a glide, adjust with the rudder, but be careful because the rudder is sensitive on high-powered machines.

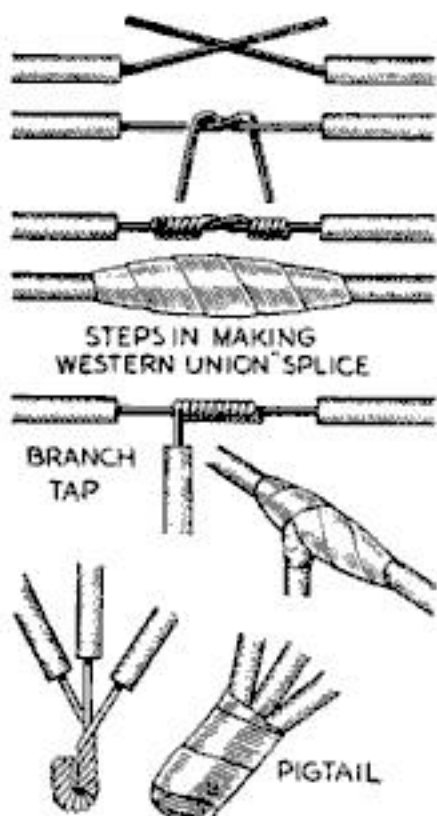
This design is considered by model airplane experts to be a logical compromise between ideal streamlining and practical application. Its construction is simple, and the aerodynamical set-up is marked by good inherent stability. A model carefully built should be able to win many contests.

Very Small Machine Screws Facilitate Repairs

THE repair of many cheaply constructed small articles can be facilitated if a supply of 2/56 flathead machine screws and nuts is kept on hand. Being only about 1/16" in diameter, the screws can be readily cut with a pair of pliers, and they are as inconspicuous as the head of a small nail. A handy length is 5/8".—J. MODROCH.

JOINTS AND SPLICES

[ELECTRICAL]



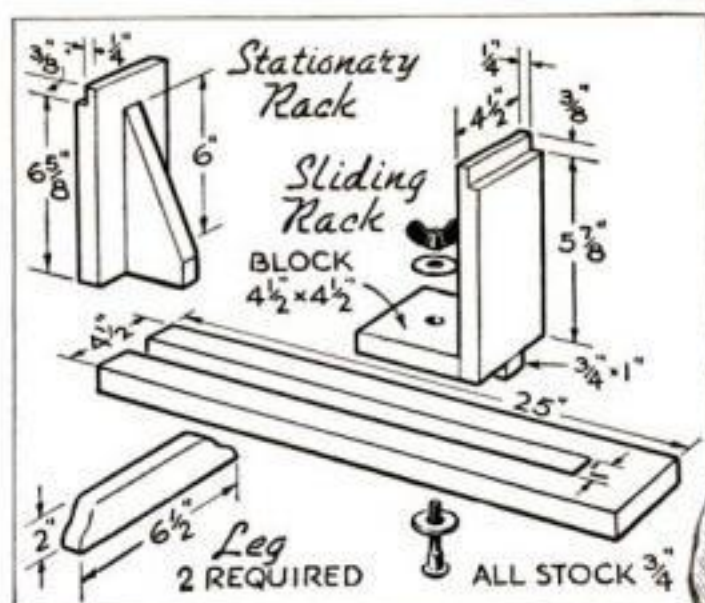
The first joint shown is an end splice for extending a wire. The second is the joint required for tapping a branch at right angles. Both are used in open wiring. The third is the pigtail joint commonly used in all junction boxes, at fixtures, and in motor terminal boxes. It is constantly utilized in conduit, BX, and similar wiring. Approved solderless connectors may be used on pigtail joints if preferred to solder and tape.

The ends of the wires must be scraped absolutely clean and far enough back to allow enough turns to make a mechanically tight joint. Solder well and wrap tightly with both rubber and friction tapes. Loosely made joints, especially if left unsoldered, can become a fire hazard.

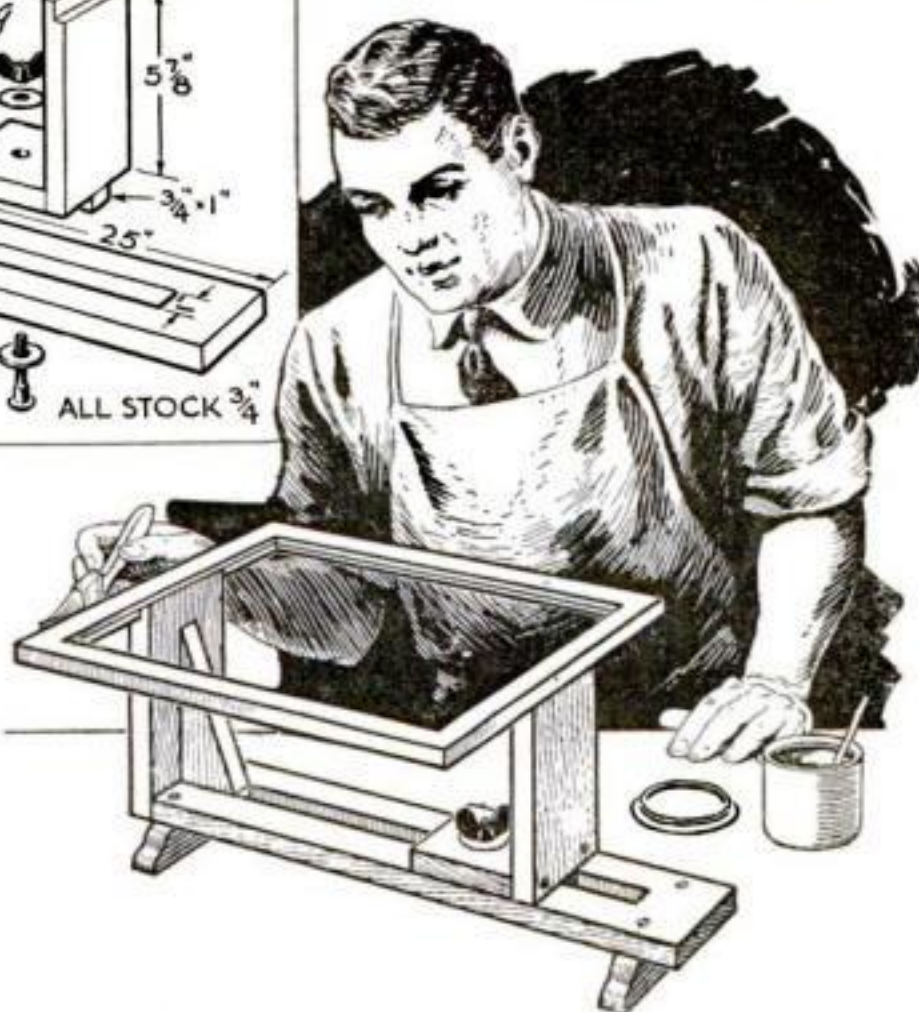
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Rack Holds Picture Frames While Being Painted

PICTURE frames of any ordinary size or shape may be held for painting in this adjusting jig. It consists of a slotted baseboard set on two legs, a stationary upright or rack at one end, and a sliding rack that can be clamped anywhere along the baseboard. The upper ends of the two uprights engage the glass rabbet of the picture frame and support it so that it will not shift while being painted. The rack is also useful for spray painting.—CHARLES JEGLINSKI,

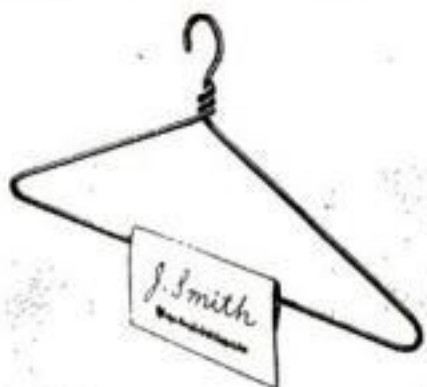


How the adjustable rack is made and, below, the method of using it to hold a frame



"Lost" Jewelry Returned with Cleaned Garments

TO INSURE the return of pieces of costume jewelry and the like to customers who negligently fail to remove them from garments sent in for cleaning, one cleaning-plant manager places the items in an envelope, which is then sealed over the crossbar of the wire hanger on which the garment is to be delivered.—G. E. H.



Picking Up Small Tacks



VERY small tacks can be picked up more easily if several dozen at a time are poured out on a rubber pad of the type shown. This pad is obtained by removing the top or finely toothed portion from an inexpensive suède shoe brush.—F. B.

ON WEEK-END camping trips, we carry our food supplies in a strawberry crate lined inside with screen wire so that no insects can get in. It forms a roomy and convenient container.—MRS. D. M. FULFORD.

Glass Case Preserves Baby's First Shoes

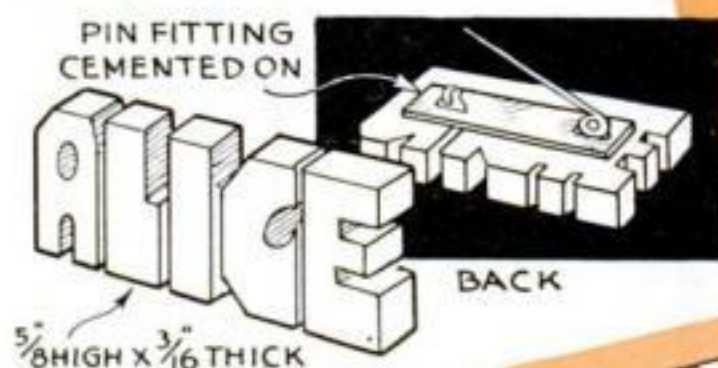
BABY'S first shoes, his first fancy Easter egg, or other small souvenirs can be preserved by making glass cases for them as shown below. A wooden baseboard of suitable size is grooved with a circular saw or by hand so that the glass sides and ends of the case can be set in and held with plastic composition wood. The ends of the grooves, if exposed, may be filled with the same composition. Cellulose cement fastens the case edges together.—WALTER W. WATSON.



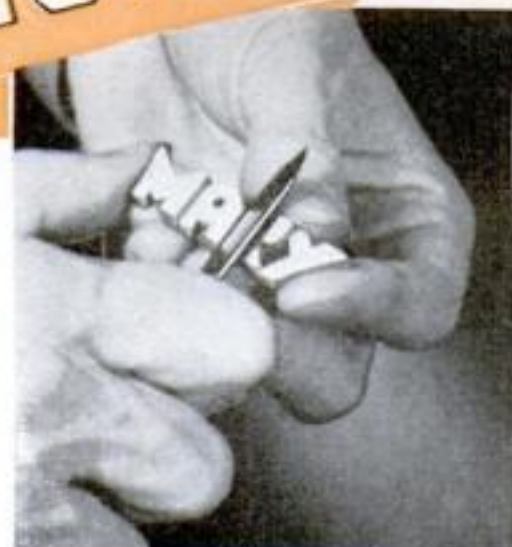
Souvenirs such as a baby's first pair of shoes are more attractive if displayed in a glass case

Name Pins, Monograms

AND OTHER JIG-SAWED NOVELTIES



Score between letters. Don't drill holes all the way through. Vary the shapes to combine neatly



WITH a jig-saw, penknife, and sandpaper, plus a little imagination, you can transform thin scraps of beautiful rare woods into name pins and brooches, monograms, name plates, and novelty cut-outs. The examples illustrated were cut from designs by the well-known jig-sawyer, H. L. Wild, of New York.

One alphabet suitable for jig-saw work is given. It is much used commercially. A single name with letters $\frac{5}{8}$ " high and $\frac{3}{16}$ " thick usually sells for from thirty-five cents up, depending upon the finish. A name cut in the same alphabet from a $\frac{1}{8}$ " by $\frac{1}{4}$ " strip brings from fifty cents up, as it is a little harder to make.

Other alphabets may be adapted from letters in display advertising and magazine head lines. Much ingenuity may be used by the designer in joining the letters in attractive combinations. A beginner had best work out the design first on tracing paper and either paste it on the

wood or trace it on with carbon paper.

Square-sided letters stand out best if divided by a shallow saw cut, or carved with a penknife as indicated in the cut-out "MARY." Such letters are also suitable for name plates in which the letters are cut out separately and mounted on a strip.

After the work has been sawed and any necessary holes drilled, it is smoothed with fine sandpaper by hand or on a disk sander. It may then be left in the "raw," rubbed down with bleached linseed oil, or coated with clear lacquer.

When the cut-outs are to be used as pins or brooches, the necessary metal fittings may be obtained from dealers in craftwork and jewelry findings, salvaged from discarded jewelry, or taken from cheap pieces purchased at a ten-cent store.





Perforated Pails Water Young Trees Slowly

NEWLY planted trees require frequent watering to insure growth, but quantities of water dashed around the roots will often flow away before soaking into the soil. To avoid this, one farmer uses a number of discarded paint pails, each of which he perforates with a small hole near the bottom. A pail is set at each tree, and the water poured into them trickles out slowly.

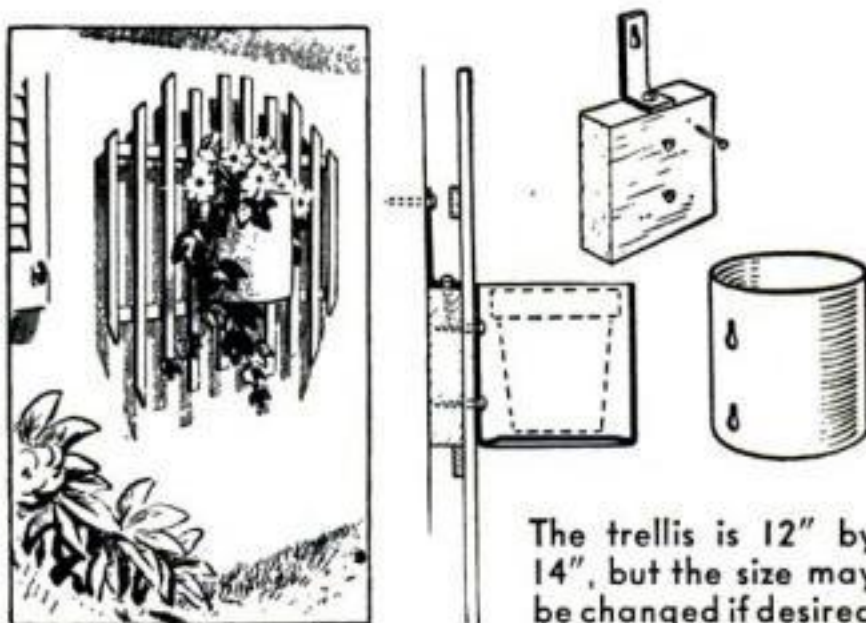


Bell Wire Ties Plants to Stakes

MUCH time can be saved by using ordinary insulated bell wire for tying up plants. It is simply wrapped around the stakes and does not have to be knotted like string. As the wire is cotton-wrapped, it is harmless to the plants, and it may, of course, be used again and again.—A. J. VIKEN.

Miniature Wall Trellis Supports Flowerpot

A BARE spot on a house or garage wall can be relieved by constructing a miniature trellis as shown. The container in the center, which is a small coffee can, holds a flowerpot with a hanging vine or flowers. The trellis is 14" high and 12" wide; the strips are $\frac{3}{16}$ " by $\frac{1}{2}$ " stock, and the hanger is $\frac{1}{16}$ " thick strap metal. Note that the lattice is held away from the wall so as to give an attractive shadow effect. Both the coffee can and the trellis itself are designed so they will lift off.—D. C.



Pair of Rubber Leggings Cut from Inner Tubes

IN CARING for bees in outyards where thistles and sand burs are present, a pair of leggings, cut as shown from inner tubes, protects the legs and ankles. The tubing is cut at the bottom to fit.

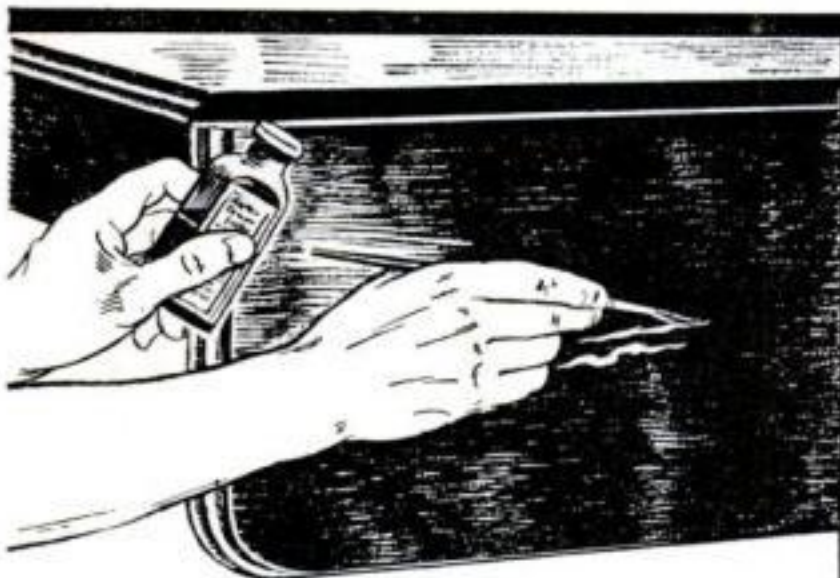




If the garden-hose nozzle is missing, a clothes sprinkler makes a good substitute



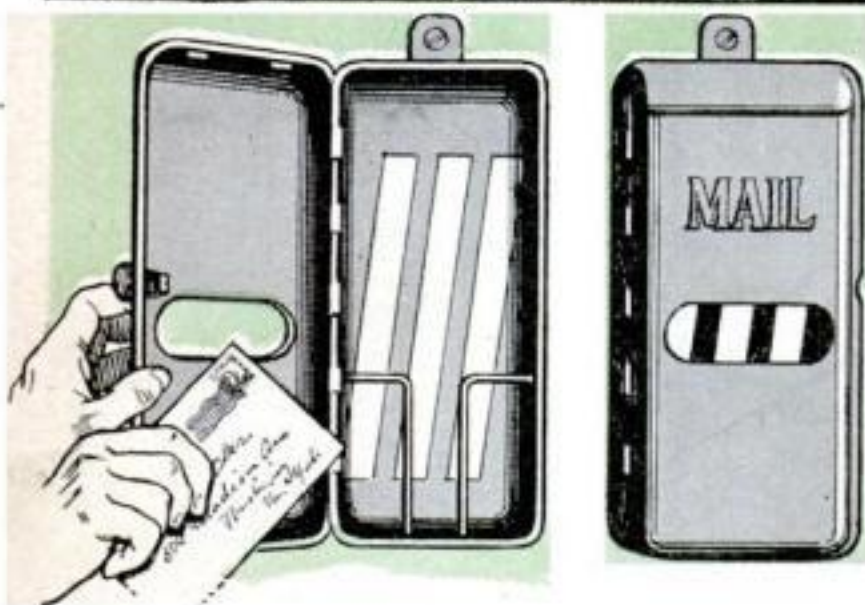
Ordinary painters' masking tape will protect any colored leather while whitening sport shoes



Ordinary tincture of iodine will conceal small nicks and scratches in dark furniture



This shelf rack is for drying vacuum bottles. Since the shelf above would be in the way, the rack tilts forward for placing the bottles and then is pushed back to lean against the wall

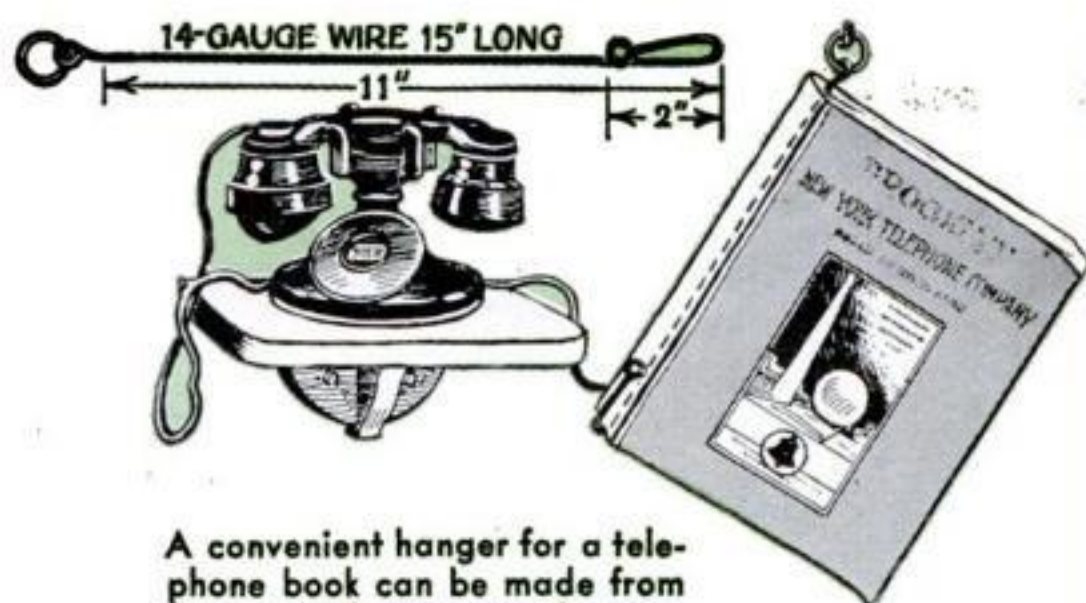


Stripes painted on the back of a letter box make it easy to tell at a glance whether any mail has been left in it. If the interior of the box is black, use strips of adhesive tape



In the kitchen a small bookshelf-desk is always useful. This one is 28" high, 18" wide, and 6" deep except for the writing shelf, which is 15"

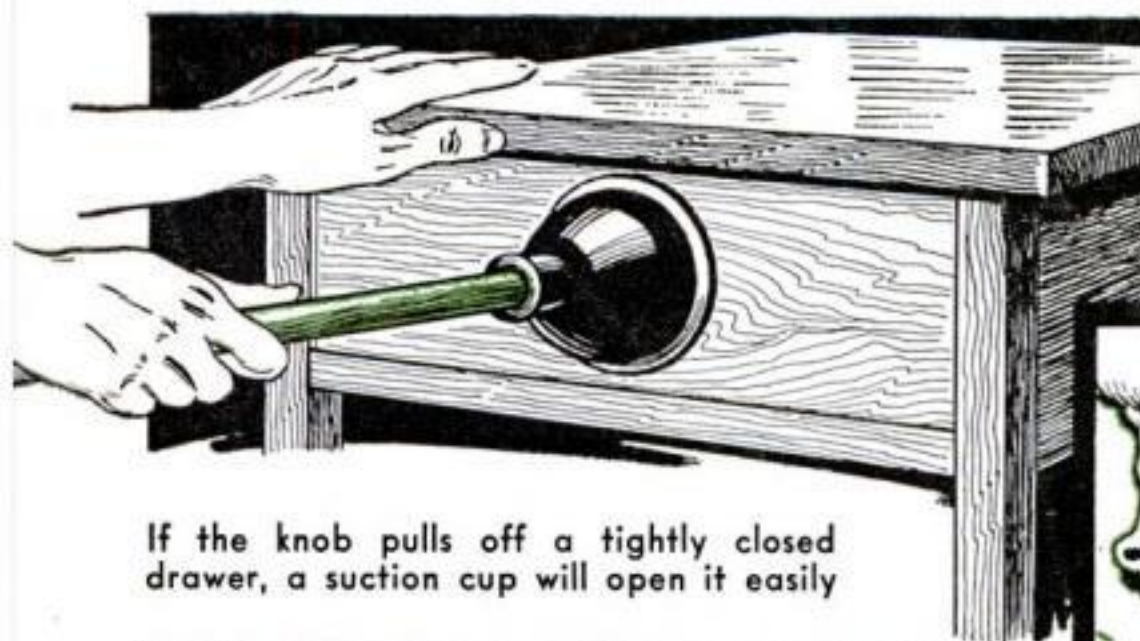
HOME SHIP SHAPE



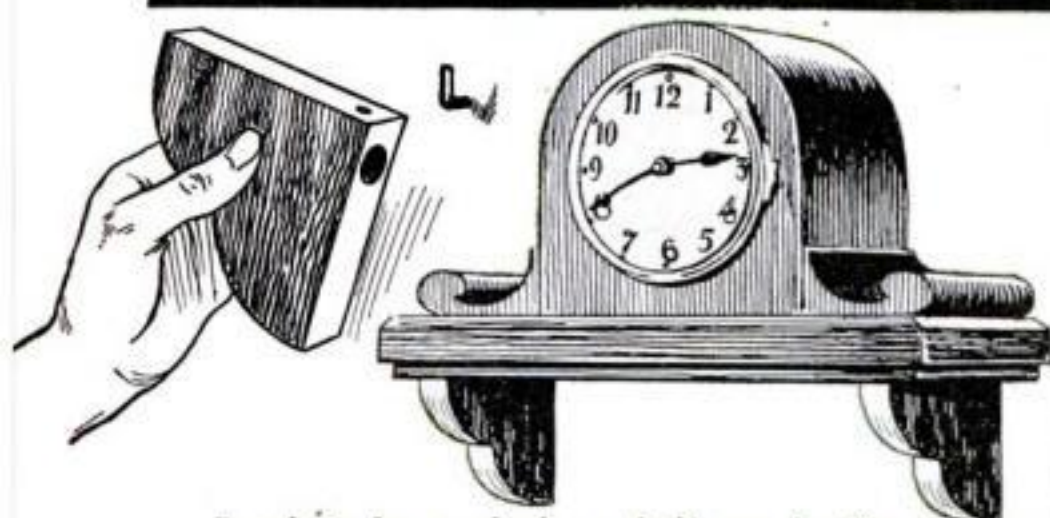
Many a good kitchen knife has been dulled or ruined by using it to scrape pots and pans, a job for which it was never intended. It is much better to keep a metal shoehorn handy for this purpose. A shoehorn is an ideal scraper for burned food that has stuck to these cooking utensils



A quick-acting holder for brooms and mops constructed from No. 9 wire and a number of lengths of windshield-wiper tubing. The block is bored with 3/16" holes on an angle and then split in two



If the knob pulls off a tightly closed drawer, a suction cup will open it easily

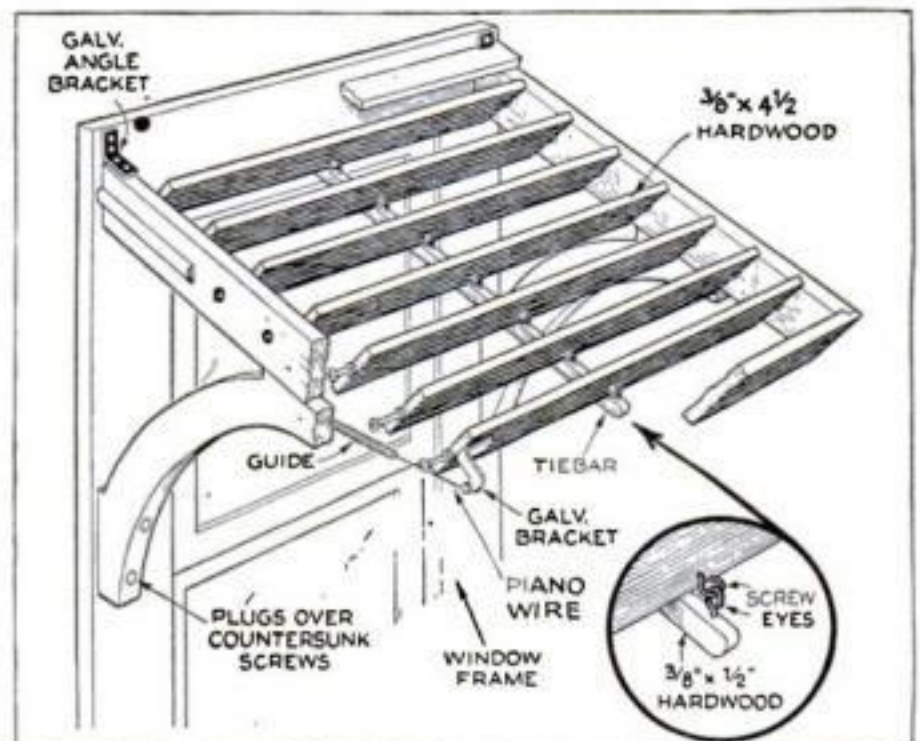


Brackets for a clock or shelf can be jig-sawed from scraps of walnut or maple and hung on the wall with L-shaped hooks



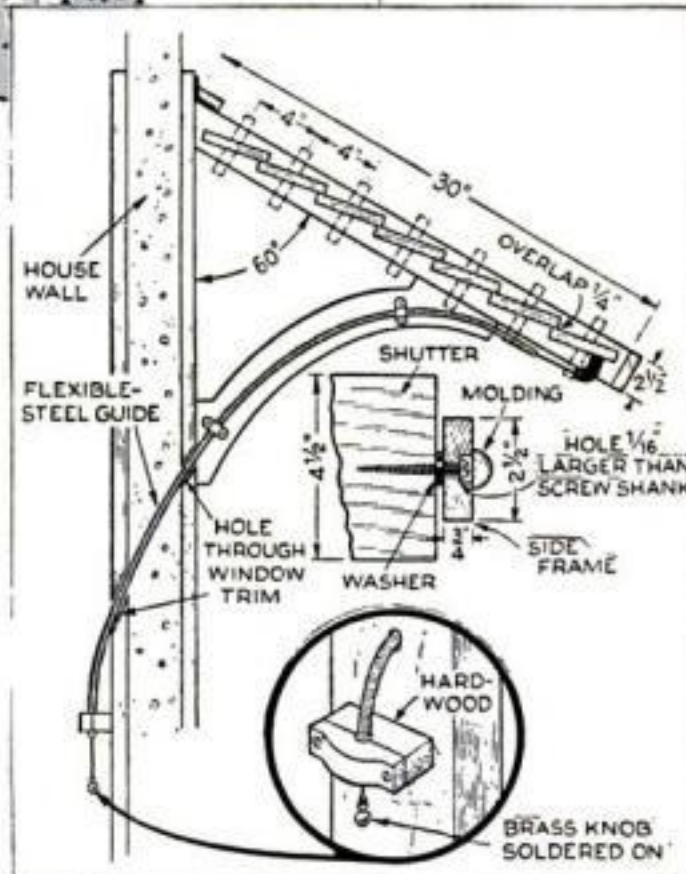
Many Girl Scouts and other girls who are learning to knit and crochet will find it an aid if they keep the yarn in a paper bag on the floor. It will then stay clean and be well out of the way

Shutter-Type Wooden Awning Adjusted from Inside



AMONG the most modern but expensive awning installations are those with adjustable shutters. Here is a neat home-made wooden awning built on the shutter principle. It will admit sunshine or shut it out as desired, and is operated from inside the house.

A series of pivoted boards, working like an old-fashioned "blind," are linked together by means of a tiebar, and opened or closed from inside through a piano-wire control. The shutters are supported by two side frames set at a 60-deg. angle and turn on long-shank, roundhead



screws, the heads being countersunk and covered with a molding. It is important that the holes drilled for the screw shanks form a fairly loose fit so that they will not tighten in damp weather.

The control is simply a length of stiff piano wire carried in a flexible steel guide. Be sure it does not interfere with window weights, if any. The equipment can be purchased at either motorcycle salesrooms or auto supply houses. When the guide is bent to a curve as shown, there is sufficient

friction on the piano wire to hold the shutters in any desired position. Hardwood about $\frac{3}{8}$ " thick or high-grade waterproof outdoor plywood of the same thickness is recommended for the shutters.—HI SIBLEY.

Bathtub Soap Dish Fitted on Kitchen Scrub Pail

A SOAP dish of the type often used on bathtubs makes a handy holder for the soap when scrubbing the floor. The wire clamp on the dish is bent with a pair of pliers to conform with the rim of the scrub pail; then the dish is slipped in place. It is easily taken off the pail when not needed, and may be hung in the closet or stored in a convenient drawer.—WILLIAM SWALLOW.



Boats Built FROM Our Plans



Scores of readers have sent in pictures of our 17' cabin cruiser. "Wherever we dock, we get a crowd of admirers," says Loren H. Katz, of Jackson, Mich., who built this one. For the plans, get Blueprints 356-7-8-9-R, price \$1.50



C. L. Giese, of Milwaukee, Wisc., gets over 30 m.p.h. with our 9' 3" fisherman's boat using a 10-h.p. outboard. "Very safe on turns," he says. Blueprints 344-5-R, 75 cents



Prom 9' long constructed by Milton H. Bernstein, Brooklyn, N. Y., from our Blueprint 339-R, 50 cents



A runabout 15' 6" long built by B. A. Alger, Belleville, N. J., from Blueprints 175-6-7-R, price \$1. Powered with a 16-h.p. outboard, it does 20 m.p.h. At right, 13' 4" racing sailboat "Black Cat" by Robert Blum, Dansville, N. Y. Blueprints 321-2-3-R, price \$1, give complete plans



Left, racing runabout (261-2-R, 75 cents) by Ed Dida, City Island, N. Y. Above, surfboard by John Clappe, Bremerton, Wash., from plans in June '39 issue

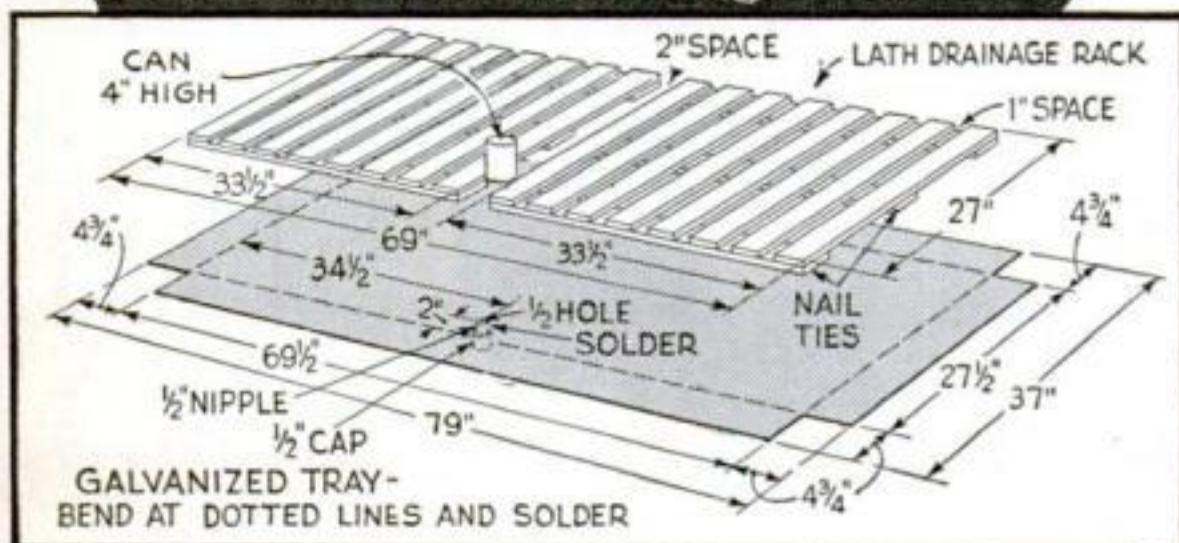
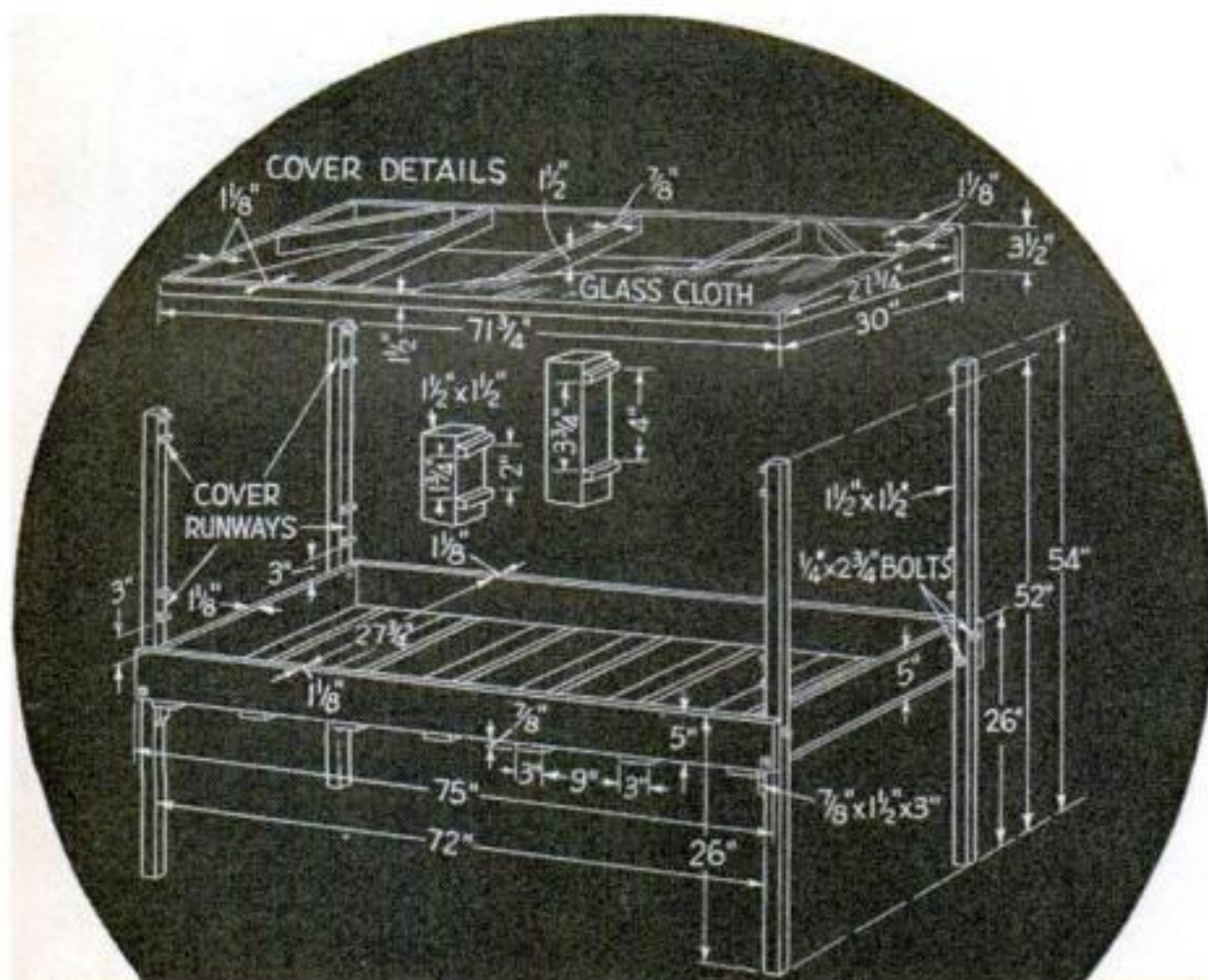
A black and white illustration of a young girl in a garden. She is wearing a light-colored dress and a wide-brimmed hat, standing with her hands clasped behind her back. She is looking at a large, rectangular wooden planter box that is filled with a variety of plants, including tall, thin stalks and leafy greens. The planter box is supported by wooden posts. In the foreground, several potted plants are arranged on the grass. In the background, a large, leafy tree stands behind the planter box, and a fence is visible in the distance. The style is a detailed line drawing with cross-hatching for shading.

A black and white illustration of a man watering plants in a raised garden bed while a young girl watches. The man is using a watering can. The garden bed is filled with various plants, and there are several potted plants on the ground in the foreground.

or with a paraffined white cloth sold for the purpose.

When moisture is needed, place the cap on the galvanized nipple which serves as the drain and pour through the bottomless can several bucketfuls of lukewarm water. Add more until the soil shows a damp spot, then immediately remove the cap and permit the excess water to drain away. Except at watering time, leave the nipple uncapped.

One of the best soil mixtures for seeds and seedlings is one part each of sharp sand, rich, sifted garden soil, and peat, the latter dampened and packed. A 4" depth, well firmed down, is sufficient. Should you



wish to root cuttings of house plants and garden perennials, use a 4" depth of equal parts of sand and peat. For best results with seeds, seedlings, and cuttings, the soil should be sterilized.

When house plants are due to be brought outdoors, remove the soil from the frame

and replace with peat, packed in almost to capacity. Into this, plunge the pots up to their rims, and pack the peat firmly around them. If the peat is kept damp, the plant roots will receive moisture through the porous walls of the pots. Syringe the plants occasionally to clean them.—R. STAHLER.

Portable Ice Box Keeps Food Fresh on Short Trips

ON WEEK-END excursions, fishing and hunting trips, and picnics, you can serve cool refreshing fruits, salads, drinks, and perishables by taking along a portable ice box of the type illustrated. It has kept as much as 20 lb. of fish at 40 deg. F. for seventy-two hours when the noonday temperature reached 90 deg. One like it can be made for about \$3. A good size is 12" by 12" by 24" outside dimensions.

The frames are 1" by 1" wood—six pieces $23\frac{3}{4}$ " long for the sides, six pieces $11\frac{3}{4}$ " for the ends, and four pieces $8\frac{3}{4}$ " for the corner posts. When these are assembled as shown, they are covered with $\frac{1}{8}$ " pressed composition wood, tacked on with 1" galvanized nails, spaced about 2" apart. Melt a pound of tar and pour all around the wood frame wherever the wood comes in contact with the covering material. Then fill the openings in the frames with rock-wool insulation.

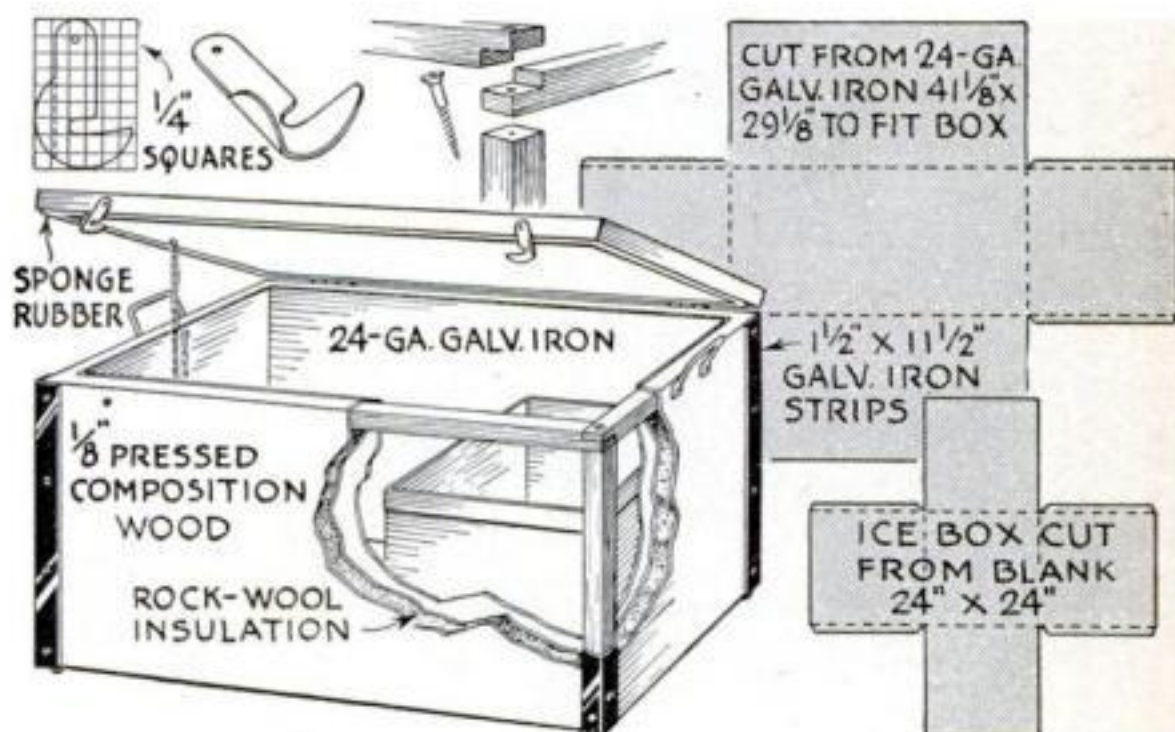
After the tank, which in this case is made from a piece of 24-gauge galvanized iron $29\frac{1}{8}$ " by $41\frac{1}{8}$ ", has been folded and soldered, test it for leaks, slip it into the frame, and nail around the top. Tack finishing strips of pressed composition wood around the top edge.

The lid frame is insulated and sealed in the same way. Tack galvanized iron to the underside, leaving a $\frac{3}{8}$ " space all around of exposed wood. To this apply sponge-rubber strips $\frac{1}{4}$ " thick and $\frac{3}{8}$ " or $\frac{1}{2}$ " wide to form a seal between the box and the lid. Put the lid in place with a 15- or 20-lb. weight on it to compress the sponge-rubber strips. Mark and drill the holes for hinges, fasteners, and pulls. Fold four pieces of $1\frac{1}{2}$ " by $11\frac{1}{2}$ " galvanized strips and drill

for nails to make corner reinforcements.

Sand the whole box and nail an angle strip to each corner. Paint the outside only with two coats of white enamel.

Make up the cracked-ice compartment in the same manner as the tank. For a box of the dimensions suggested, it can be about 8" by 8" by 8". Screw a brass chain about 10" long to the lid and the other end to the inside of the frame.—E. T. DAHLIN.



Behind the Scenes of a

By
JOHN H. WOOD

ESLIE E. Poole, of Portland, Ore., is a structural engineer; Amo DeBernardis is an industrial arts teacher; Delbert D. Fisher is a dentist. But when these three men get together, they have a common interest—the home workshop hobby. They are the officers of the Portland Homeworkshop Club, a club which in four years has grown to be one of the most outstanding groups affiliated with the National Homeworkshop Guild.

The Guild was formed nearly seven years ago, but not until November, 1936, did some of Portland's amateur craftsmen band together and become associated with the national organization. There were twenty-three members then; now there are over sixty.

Upper left, display of toys made by the Portland (Ore.) Homeworkshop Club. Left, Bernard McKain demonstrates wood turning. Below, this shop is owned jointly by L. W. Anderson and A. H. Vance



Home Workshop Club

They come from all walks of life. A recent survey revealed the following occupations: refrigerator repairman, locomotive engineer, structural engineer, civil engineer, metal spinner, hotel man, two hardware buyers, two machinists, banker, two truck drivers, cobbler, creamery worker, undertaker, commercial photographer, millwright, two decorators, attorney, three accountants, river pilot, three dentists, two bakers, shoemaker, druggist, auto salesman, two drug salesmen, department manager, insurance man, janitor, teletype repair man, three industrial-arts teachers, two window trimmers, three salesmen, two clerks, and a carpenter.

A visit to their homes emphasizes even more fully the difference in their modes of life, but proves that they are enthusiastic craftsmen. All of them have shops, and forty-six own power tools.

Early last year the members decided they wanted a permanent meeting place where they could have a shop and an instructor. The city's coöperation was sought and finally obtained. Now meetings are held twice a month at the Edison High School, except for special meetings at members' shops or visits to nearby factories.

Each year the club assists the Portland Fire Department in making toys for the city's poor children. In 1939 every member guaranteed to make at

least ten toys, and the 600 toys were exhibited in a store window for several days before being distributed at Christmas. At various times during each day, a member would give wood turning demonstrations at a lathe set up in the center of the display.

The photographs on these and the following two pages give a good idea of what this club and its members are like.

Furniture for a local old people's home is being made by the Inland Homeworkshop Club, *Spokane, Wash.* Secretary W. R. Matthews says, "We are farming out the parts to the members according to their equipment and will assemble and finish the pieces at future meetings. In this way each member does the work he likes best and is



Delbert D. Fisher, secretary, at his band saw making toys for distribution to poor children



Leslie Poole, president of the club, cuts up materials for model boats while his son George works beside him assembling the parts

Amo DeBernardis likes to work in metal. Here he is spinning a candy dish. When he makes toys, his wife, below, assists him. She is shown painting uniforms and faces on an army of wooden soldiers



Amateur Craftsman Club . . . "Chips" is the name of the mimeographed magazine being published by the *San Diego (Calif.)* Homecraft Club for its members . . . The *Billings (Mont.)* Homeworkshop Club has voted to make new toys this year rather than repair old ones . . .

Hooked rugs are being made by the women members of the Hickory Homeworkshop Club, *Scituate, Mass.* The men are designing and building furniture pieces . . . A moving picture, "Round the World by Telephone," was shown to the Town Hall Homeworkshop Club, *Ottawa, Ill.*

Thomas Graveline demonstrated his new circular saw when the Al-co-ny Homeworkshop Club, *Albany, N. Y.*, met at his home . . . Demonstrations on the use of lathe, circular saw, and band saw have been given at meetings of the Black-Rock Homecraftsmen, *Buffalo, N. Y.* Several members have constructed their own power tools . . . The Homecraftsmen of *Long Beach, Calif.*, are making projects for the Red Cross and Children's Day Nursery . . . The "workshop widows" of the *Ashland (Ohio)* Homeworkshop Club gave the members a St. Valentine's Day party. Partners were matched by valentines, and each member presented his partner with something he had made . . . An exhibition of wood carving was given by M. D. Franklin before the Montgomery Homeworkshop Club, *Bethesda, Md.* Leroy Allison showed how to file a saw blade, and C. C. Clagert demonstrated how to sharpen chisels.

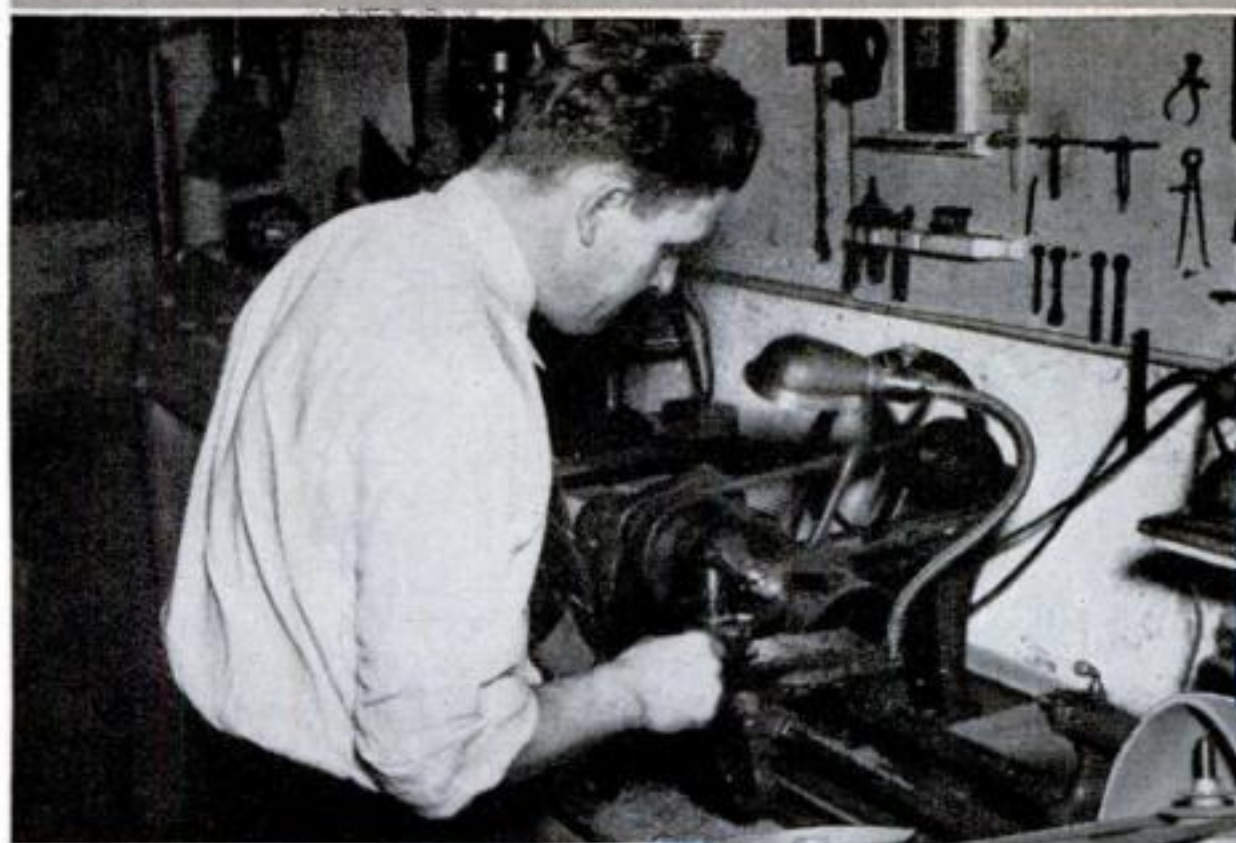
The Eastmoreland Homeworkshop Club,



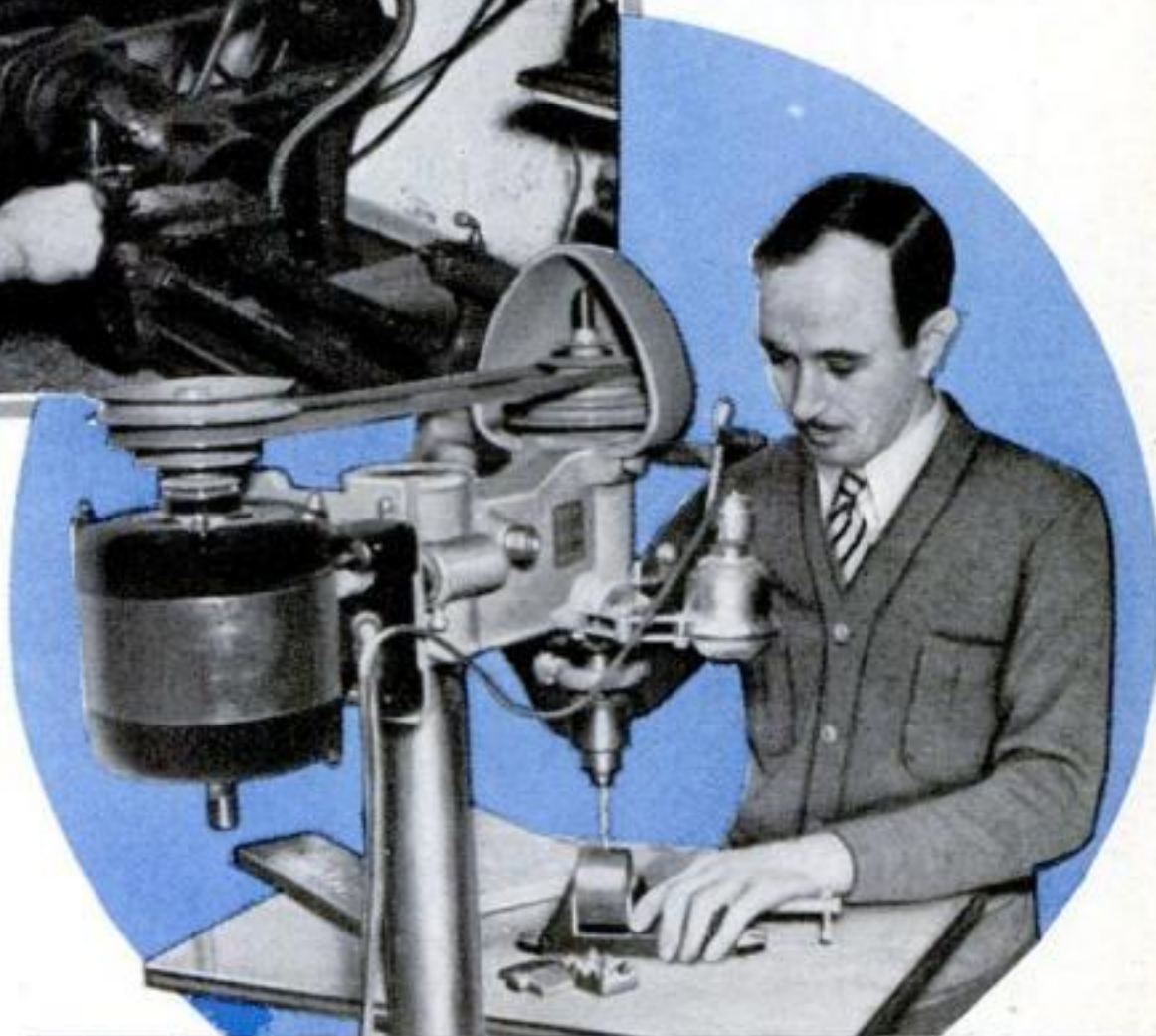
Chester Schwanberg is adept at wood turning

best fitted for." Moving pictures were shown at recent meetings.

The *Racine (Wisc.)* Homeworkshop Club has rented an empty store and is fitting it out as a club workshop . . . Thomas Griswold, a consulting engineer, spoke on "Power Tools—Purchasing Them, and Their Care and Upkeep" before the *Midland (Mich.)*



Herbert Tollisen smooths up a rough casting in his metal-turning lathe. Below, Clair Turner at his drill press. Nearly all the members have elaborate workshops containing power equipment in addition to hand tools



Portland, Ore., gave an exhibit at the Duniway School. Models and leatherwork were displayed.

T. E. Stepan demonstrated a new planer attachment for his drill press before the *Vicksburg (Miss.)* Homeworkshop Club. Samuel Albrecht was named program chairman.

The Southeast Woodcraft Club, *Cleveland, Ohio*, has purchased a band saw; other power tools will be obtained later. At present the members are making toys.

Plans for exhibiting in the Saanich and Victoria fairs next fall have been made by the Saanich Homeworkshop Club, *Victoria, B. C., Canada*.



Harvey Summers has equipped his garage with apparatus for casting metal parts



Left, E. L. Mallory uses the jig saw, which ranks third in popularity with the club members. The bench saw is first, the wood-turning lathe second

Vacuum Sweeper Used to Clean Dry Dust Mops



EVERY housekeeper who cleans floors with a dry dust mop has to take extra steps and exposes herself to colds by opening a window or by going outside to clean the mop. The vacuum mop cleaner illustrated can be used inside and does the work better.

From three-ply wood or other light material, construct a box 2" by 12" by 24" and glue all joints to make them air-tight. In the top, cut a 3" by 6" hole, 10" from one end. Cut a similar hole in a rubber kneeling pad and glue over the hole in the box. This hole may have to be longer to clear the rotating brushes on some sweepers. Attach a block to keep the wheels from rolling.

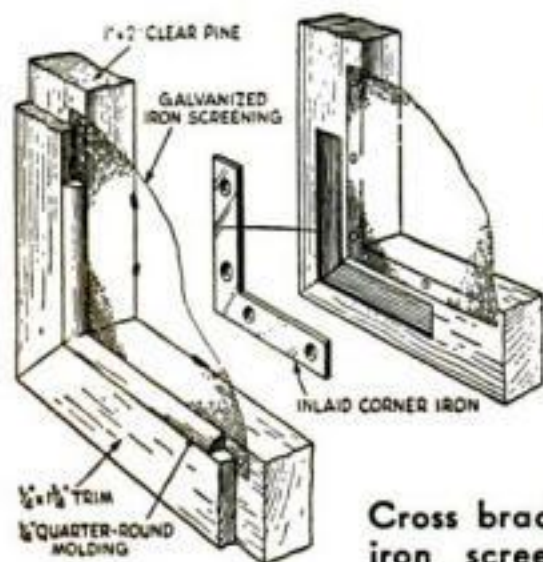
Two inches from the other end of the box, cut a 7" by 7" hole. Around this construct a funnel from 1" by 6" pine. Across the bottom, fasten a piece of mesh or so-called "rat" wire.

Leave the cleaner in the closet where the sweeper is kept, or move it to the location of the cleaning. Set the sweeper in place over the rubber pad and turn on the motor. When the mop is placed in the funnel, it is vacuum-cleaned.—WILLIAM A. HARRIMAN.

Screen Door Needs No Bracing

IF A GOOD grade of galvanized-iron screening is used in making a modern screen door like the one illustrated, no bracing will be needed. The strength of this type of screening will not permit the lightweight frame to sag. Both frame and wire may be painted to match the regular house door. Before painting the screening, however, thin the paint with turpentine and a little dryer to prevent clotting the mesh. An air-compression door closer can be screwed to the top of the frame.

Copper screening is not recommended for this type of door because of its tendency to stretch out of shape.—J. MODROCH.



Cross bracing is unnecessary with galvanized-iron screening. Angle irons are sufficient

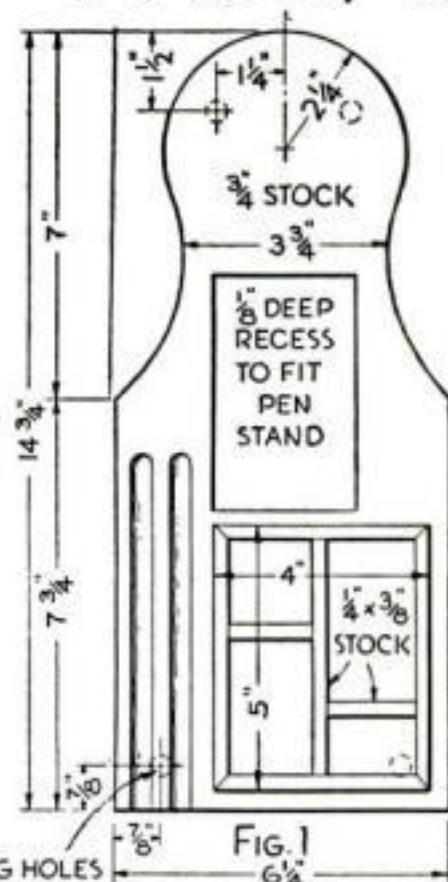


Brass Strip Keeps Outboard in Place

TO PREVENT the loss of an outboard motor through the clamps working loose because of the vibration, merely screw a brass strip $\frac{1}{2}$ " thick, about 1" wide, and from 12" to 15" long to the inside top edge of the transom in such position that the pads on the motor clamp screws are below it when the motor is in position. Even if the motor is not clamped on securely, it cannot come off.



The drawer is made to hold fifty cigarettes in a "flat-fifty" tin



Miniature Cobbler's Bench

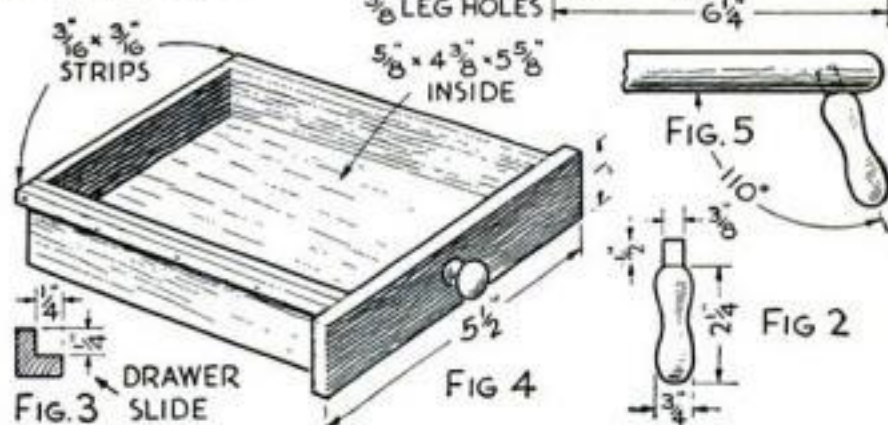
SUPPORTS DESK LAMP

PATTERNED after a cobbler's bench, this walnut desk lamp is an appealing project. The miniature tray holds paper clips, rubber bands, and other supplies.

Cut the bench top to the general contour shown in Fig. 1. Recesses $\frac{1}{8}$ " deep are made to fit the pen and pencil. A complete lamp not exceeding 12" high over all and with a base $3\frac{3}{4}$ " in diameter or less may either be purchased or constructed.

If a lamp is made with a glass base, it is necessary to bore a hole for inserting a length of $\frac{1}{8}$ " threaded tubing, which is fastened to the electric socket and underneath the bench top. The required metal parts for the lamp can be obtained at almost any electrical supply house.

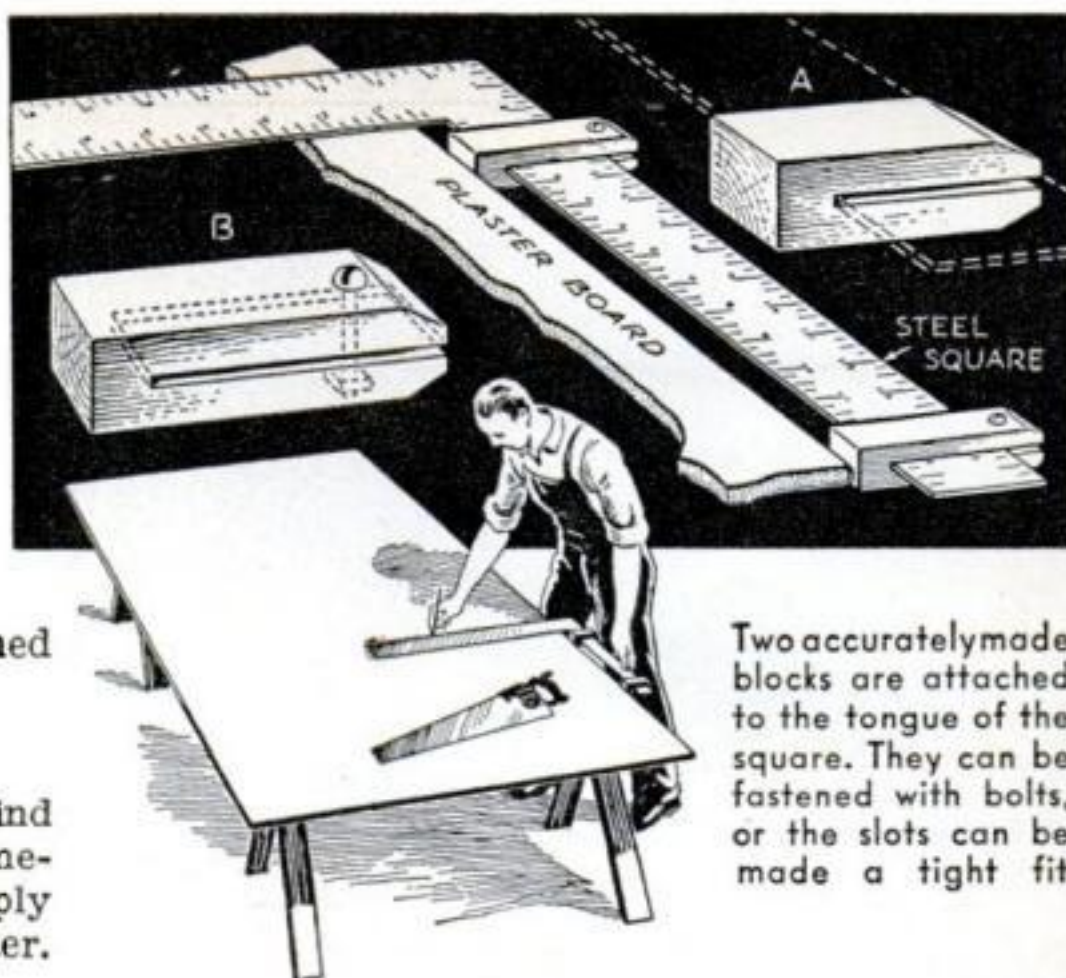
Figure 3 shows the drawer slides, which are nailed underneath the bench top. Make the drawer as shown in Fig. 4 from $\frac{3}{16}$ " stock. Holes for the legs (Fig. 2) should be bored so that the legs have an outward slant of 110 deg. from horizontal (Fig. 5). For the finish, a filler is required, with three successive coats of clear varnish, rubbed down and then polished.



The lamp base is held inverted on a tightly fitting wooden disk which has been nailed to a board and clamped on the drill table. A wall of putty is built on the bottom of the base to hold a solution of medium-grain abrasive and water or turpentine. Drill with $\frac{7}{16}$ " copper or brass tubing, and use an up-and-down movement

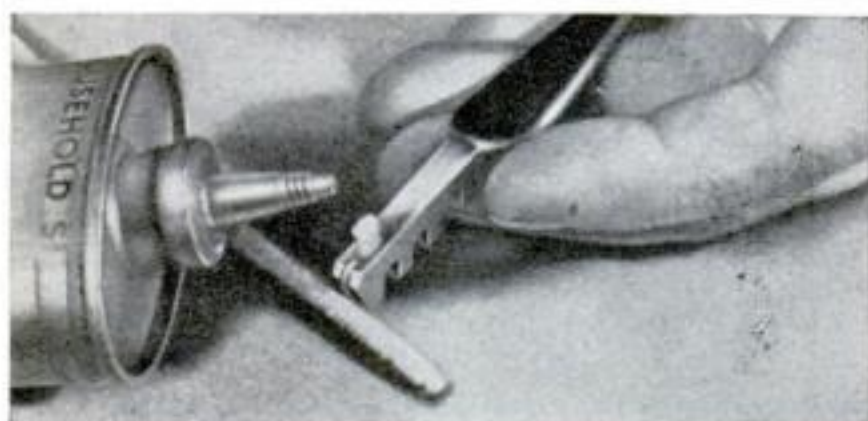
Using Steel Square on Plaster Board

LINES can be squared more easily with a steel square across round-edged sheets of plaster wall board and similar materials if two blocks are added to the tongue of the square to give a wide surface to press against the edge. The blocks may be made short as at A and held in place with friction tape, or longer as at B. The latter are slipped on over one end of the square and tightened with bolts.—HOWARD WILLIAMS.



Two accurately made blocks are attached to the tongue of the square. They can be fastened with bolts, or the slots can be made a tight fit

Two easily remembered ways to find area of a circle: Square half the diameter and multiply by 3.1416, or multiply circumference by one quarter diameter.



Oiling a Glass-Cutter Wheel

A GLASS cutter can be lubricated automatically by inserting a piece of pipe cleaner behind the wheel, cutting off the excess, and soaking it with light oil.

Hammers Hang on Nails

THE simplest way to park one or more claw hammers above the workbench is to drive stout nails part way into the wall or tool board so that they project about 1". Just slip the claws down over the nails as shown. The handles stick out where they are easily grasped when needed.—W. B.



CLEANING DECORATIVE METAL WORK

[METAL WORKING]



PROPER cleaning is the first step in the successful finishing or coloring of decorative metal work. After copper or brass is annealed, most of the scale will be removed if the piece, when taken from the fire, is immediately plunged into cold water.

To clean brass, go over the surface several times with a swab that has been dipped in full-strength muriatic acid, then immerse in cold water. Do not thereafter touch the cleaned surface with the fingers.

Copper, bronze, and nickel silver are all cleaned in the same manner except that full-strength commercial nitric acid is used instead of muriatic.

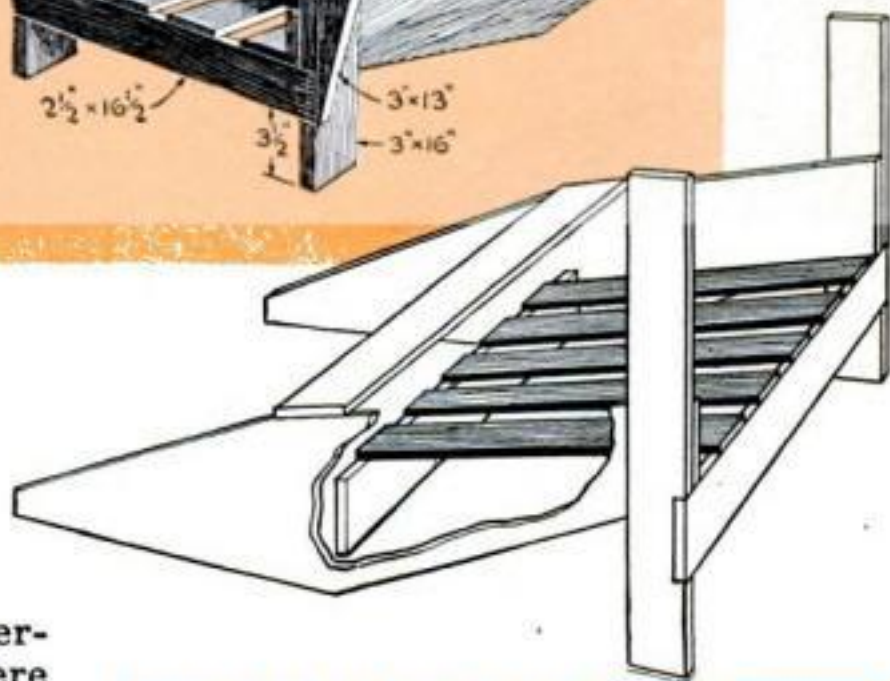
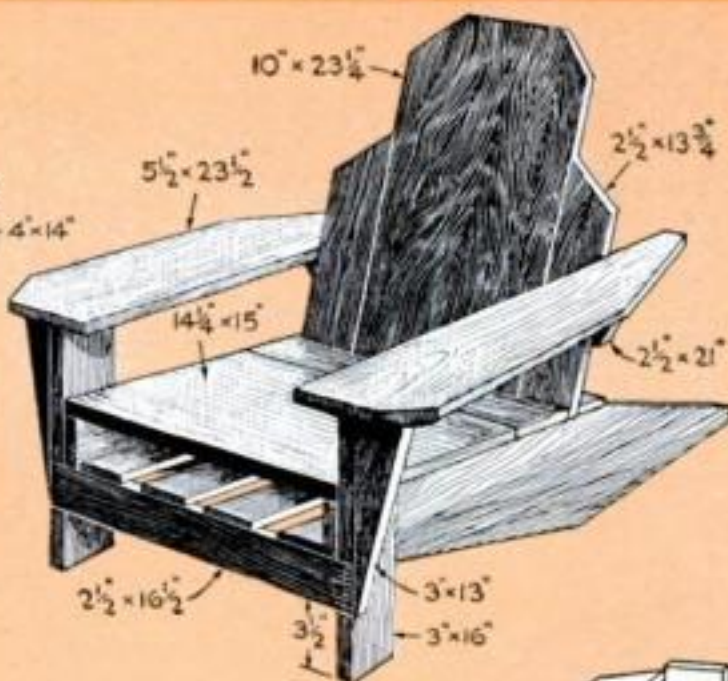
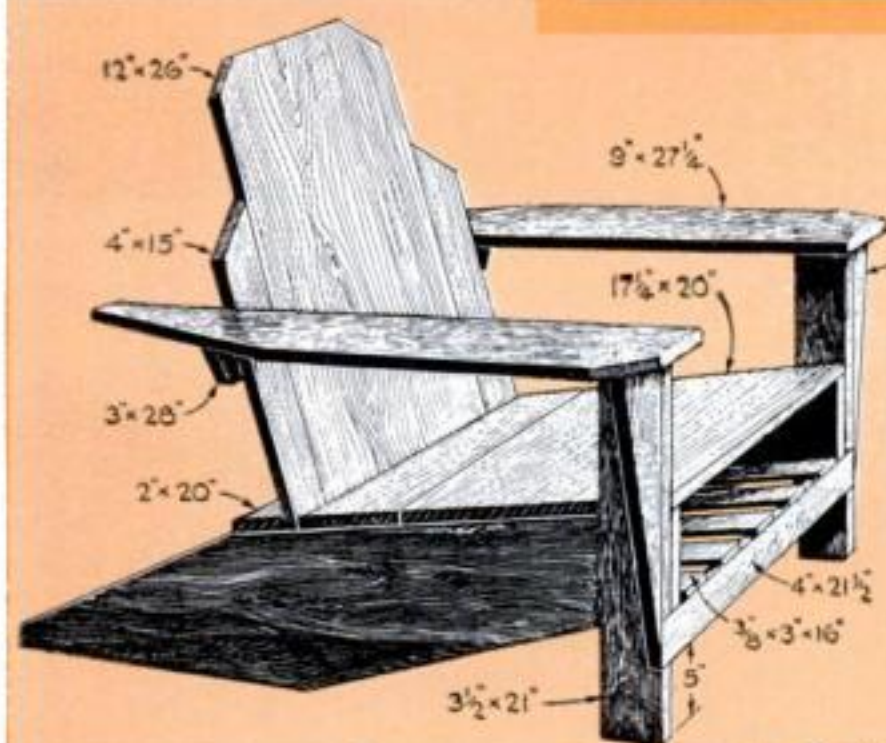
If the pieces are to be polished, scouring them lightly with ordinary dry building lime, whiting, plaster of Paris, or other slightly abrasive powder immediately after cleaning will make polishing easier.

Great care should be exercised not to allow any of the acids to come in contact with hands or clothing.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

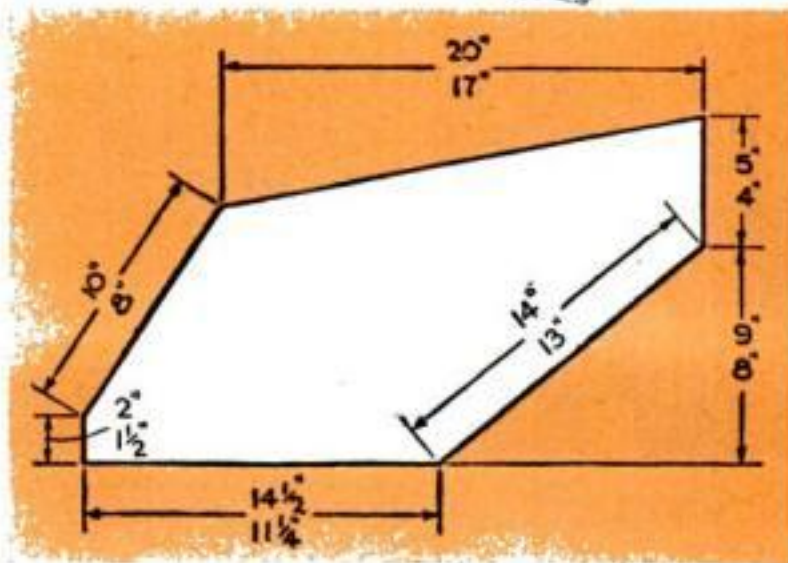
Porch and Lawn Chairs

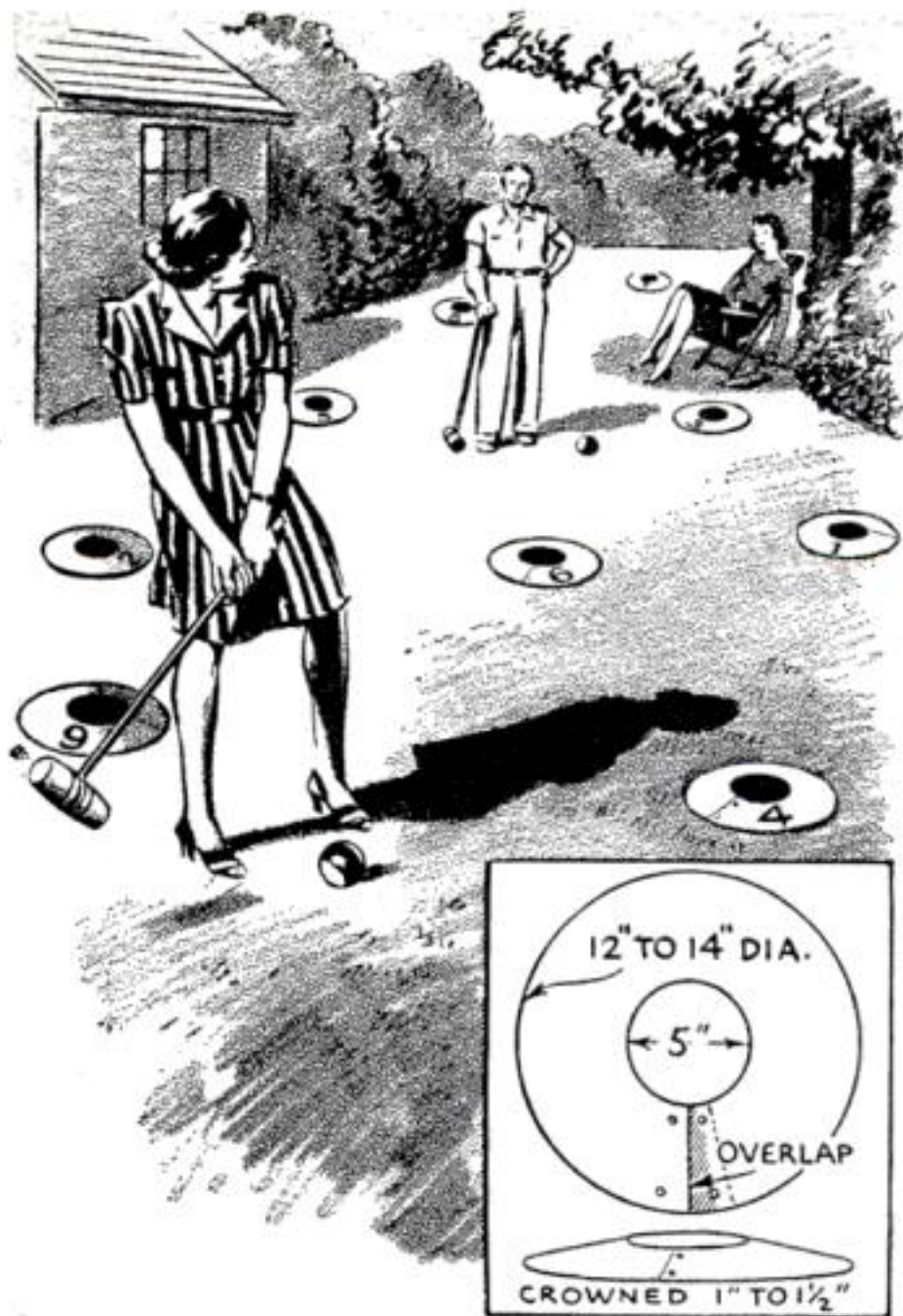
WITH
MAGAZINE
RACKS



COUNTLESS variations of the popular Adirondack camp, lawn, and porch chair are made, and they can now be bought so cheaply "knocked down" that it hardly pays to build them unless suitable scrap boards are available. Nevertheless, readers frequently ask for plans, so here are drawings of an especially comfortable full-size chair and a child's chair to match as made by C. L. Stevenson, North Hollywood, Calif. The dimensions and shape of the back may be varied as desired. A hammer, handsaw, chisel, and rule are the only tools needed.

The design includes a magazine rack which can be built in with little extra trouble. The arm rests are wide enough for writing letters, or you may serve refreshments on them without dragging out a table. In the rack of the smaller chair, a child can keep paper, crayons, and books, and the arm rests serve as a desk.



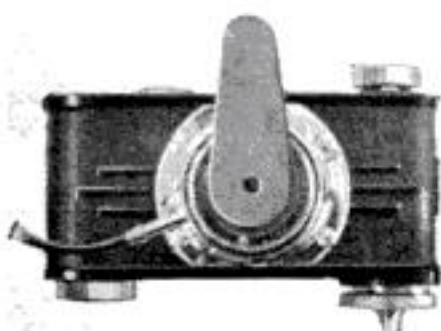


Lawn Golf Game Played with Croquet Set

CROQUET golf, played with croquet balls and mallets, is an entertaining lawn game. The golf holes are made of any available galvanized iron such as secondhand roofing sheets. They are 12" or 14" in diameter with a 5" hole cut in the center. It is best to have the cutting done at a tin shop on the circle shears. Each ring is cut in one place, and the ends are lapped over and riveted together so as to crown up the center about 1" or 1½". Nine holes are required, and numbers are painted on them from 1 to 9. These are placed in odd places about the lawn, and the game is then played the same as regular gold.—H. W.

A Lens-Cap Reminder

AFTER buying a miniature camera supplied with a lens cap, I sometimes forgot to remove the cap before making an exposure. To prevent this, I cemented a piece of rubber on the cap so that it would project in front of the view finder, where I cannot help but see that the cap has not been removed.—R. O'C.

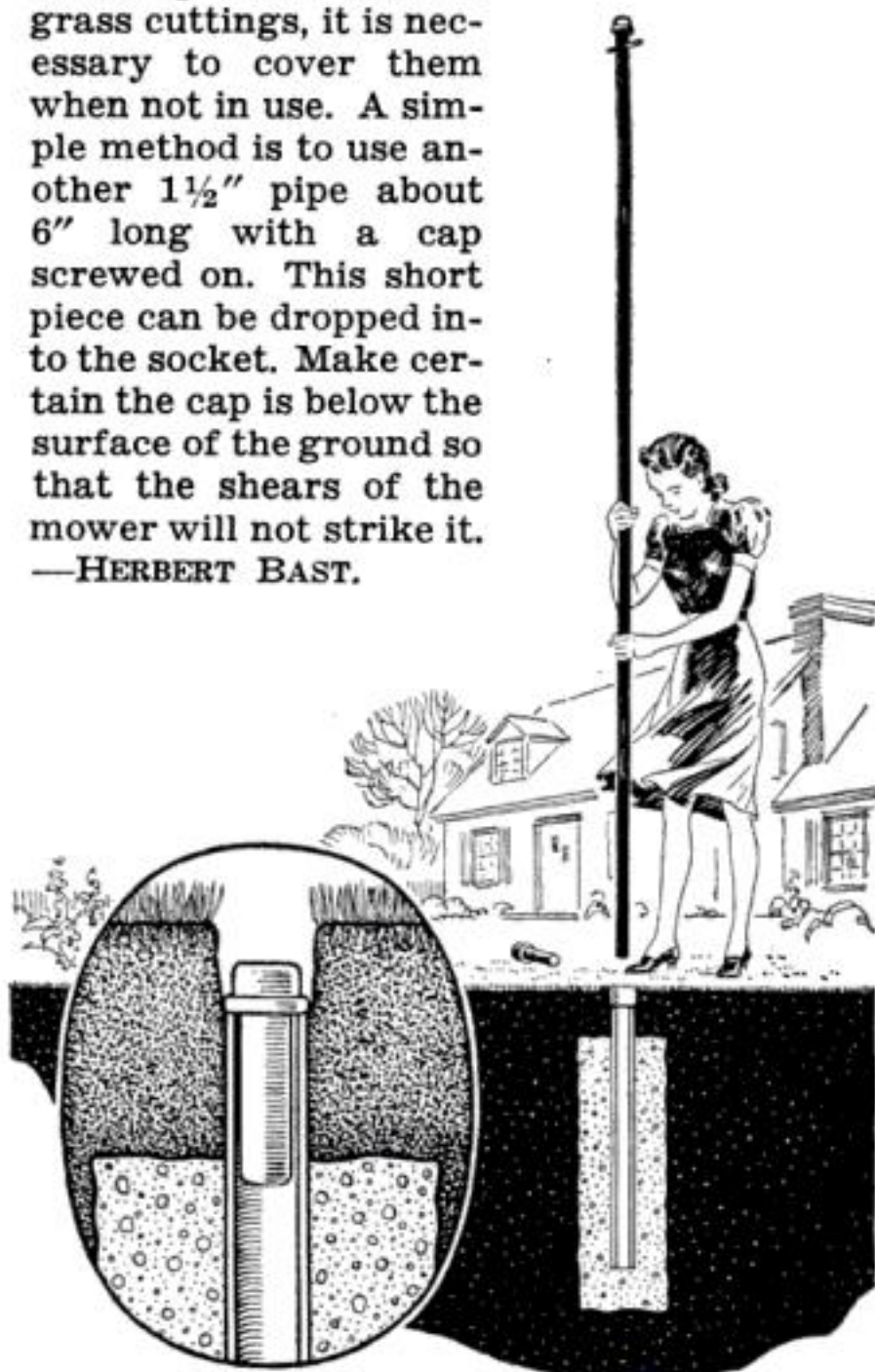


Removable Iron Posts Support Clothesline

PERMANENT clothesline posts, especially on corner lots, are far from decorative and always in the way when the lawn has to be mowed. It is better to use removable iron pipes for the posts, which may then be stored in the garage or elsewhere when not needed.

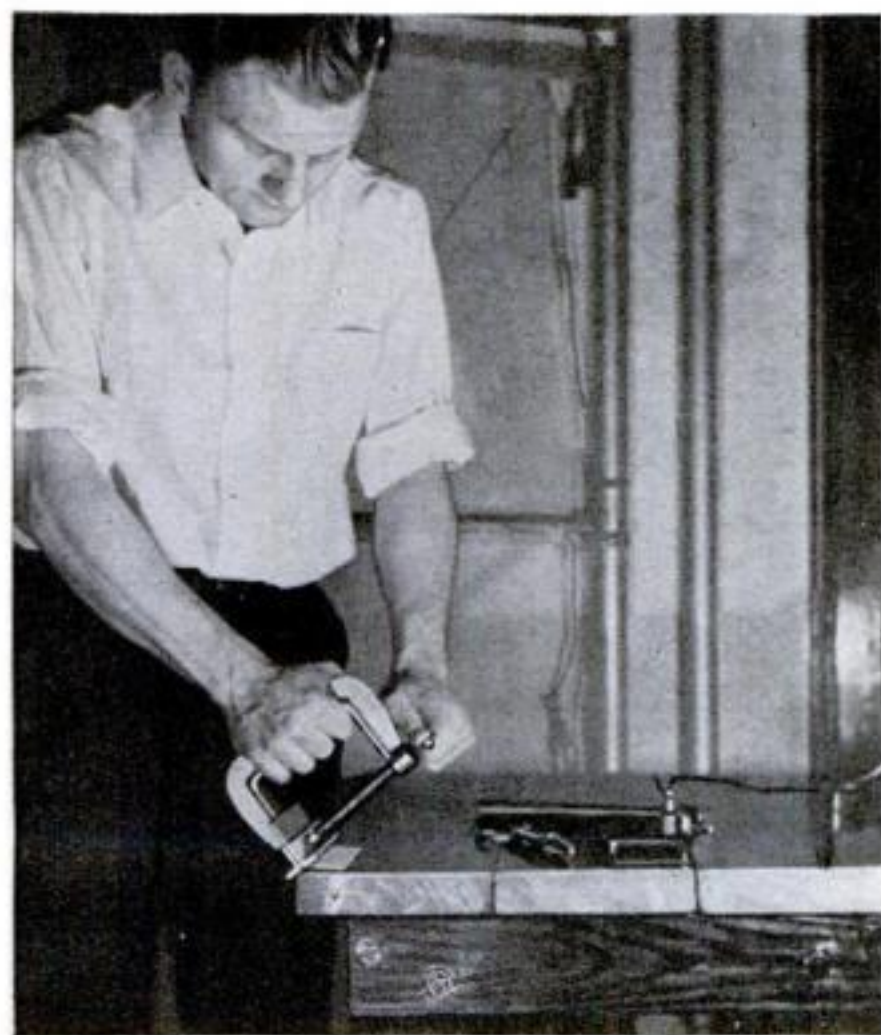
Cut as many posts as desired from 1½" iron pipes, making them about 9' long. The pipes can frequently be purchased secondhand at a wrecking company for a reasonable sum. Drill a ½" hole through each about 3" from the top. Through this run a ½" iron rod about 6" long and weld it centrally into place, or have it welded. For a neater appearance, an iron cap can be screwed to the top of the post. Paint the posts with a metal primer and two coats of high-grade enamel suitable for outside use on metal.

Set into the ground at each position another iron post about 30" long and just a little larger in diameter than the 9' posts. The top should be about 1½" below the level of the sod roots, and the pipe should be embedded in concrete, the top of which is about 8" below the surface so the sod will grow freely over it. To avoid having these sockets filled up with dirt or grass cuttings, it is necessary to cover them when not in use. A simple method is to use another 1½" pipe about 6" long with a cap screwed on. This short piece can be dropped into the socket. Make certain the cap is below the surface of the ground so that the shears of the mower will not strike it.—HERBERT BAST.



Bending Light Sheet Metal

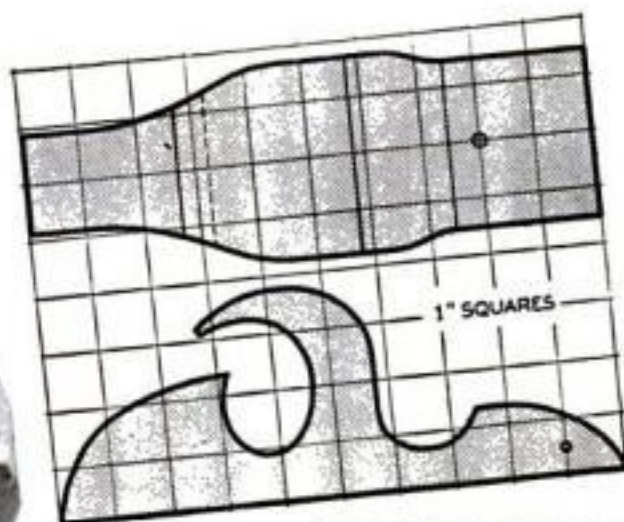
NEAT bends in light sheet metal can be made without special tools by using a large C-clamp and two pieces of 1" angle iron or hardwood. Clamp the metal between the angle irons and bend on the edge of a table or plank as shown. For larger work, two clamps may prove more satisfactory.—L. R.



Handy Reel for Carrying Electric Drop Cord

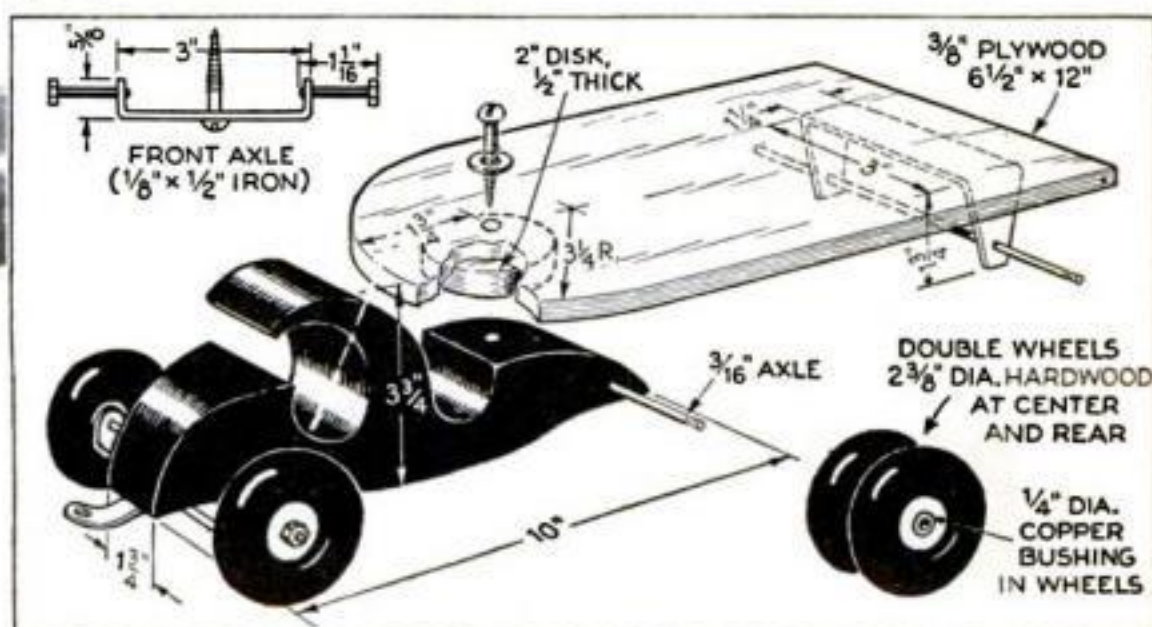
TO AVOID tangling and soiling the coil of drop cord he carries about on wiring jobs, one electrician constructed a simple reel by mounting two short sections of auto tire casing on a piece of plywood. The rubber retaining pieces are easily bent to drop the coil in place, but remain in position to support and protect the coil when carried from place to place.

A Toy Trailer Truck to Delight Any Small Boy

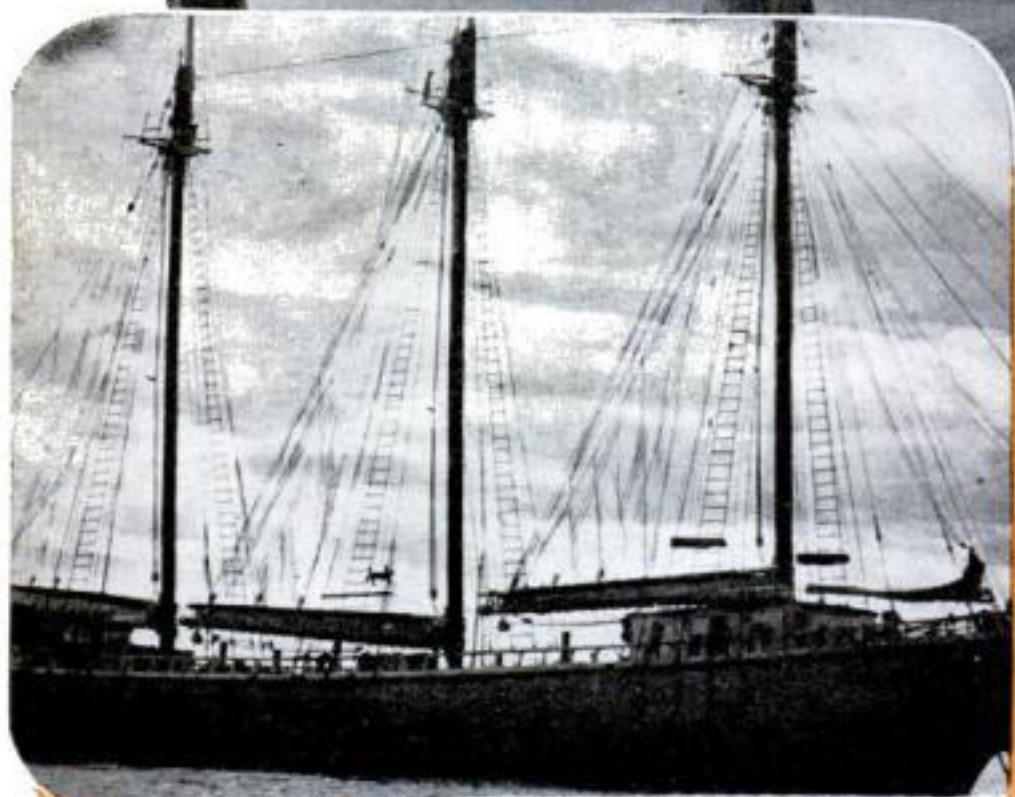
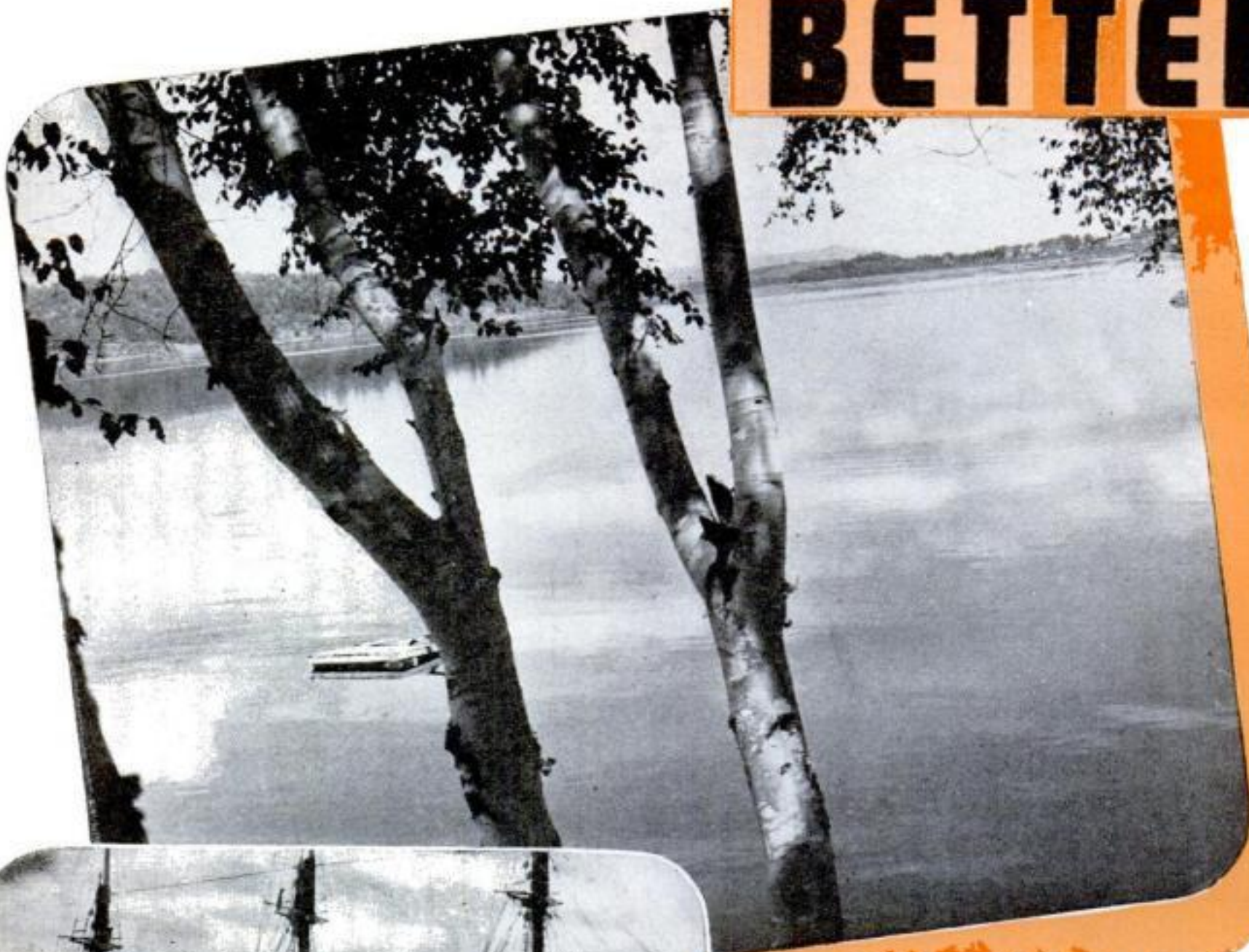


A SMALL boy can get a lot of fun playing with this sturdy toy truck. It was designed by a member of the Walla Walla, Wash., Homeworkshop Club, and the drawings were supplied by Jennings Johnson, president of the club. The cab is band-sawed from a block of pine $3\frac{1}{2}$ " by 4" by 10", which may be glued up with waterproof casein glue. The body is $\frac{3}{8}$ " waterproof plywood $6\frac{1}{2}$ " by 12".

The toy is sturdy enough to withstand considerable abuse from a child. Band-saw the cab from a block of pine. Turn the wheels from hardwood and form the axle braces from pieces of strap iron



BETTER



Two shots from the same point of view. Above, with a regular movie lens; at right, with a wide-angle lens

At the top of the page is a scene to show how the reflection of clouds in calm lake water can add beauty



THERE must be something magic about the word telephoto. Nine times out of ten, after a man has bought a 16-mm. movie camera, his next purchase is a telephoto lens for it, yet if he is the average photographer and wants the lens to help him get better vacation movies, a wide-angle lens

will prove a lot more useful than any of the telephoto types.

Consider the pictures you are likely to want to take, and compare the picture angle of the 16-mm. movie lenses with those of the ordinary still camera. You will find that the regular lens on your movie camera really is a telephoto when judged by still-camera standards. For example, a lens of about 6" focal length is commonly used on

VACATION MOVIES

A wide-angle lens and the proper filters will catch all the beauty you see on your trips this summer

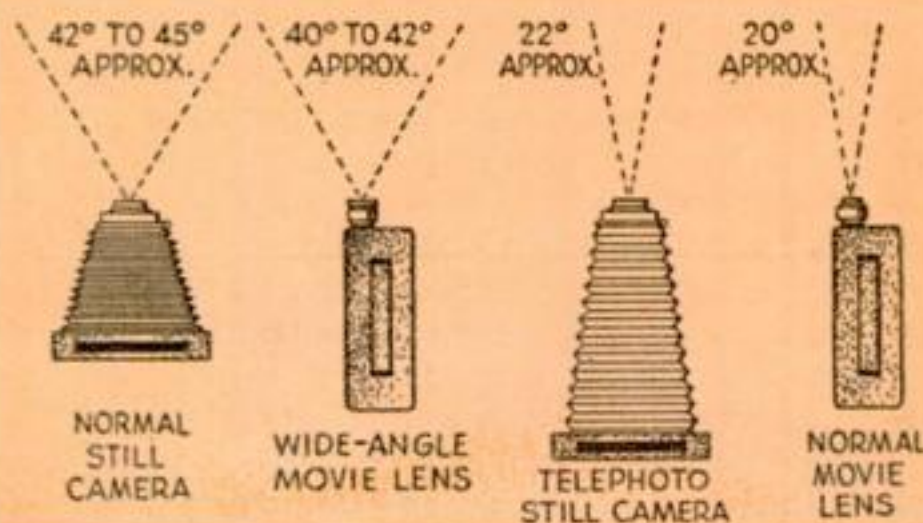
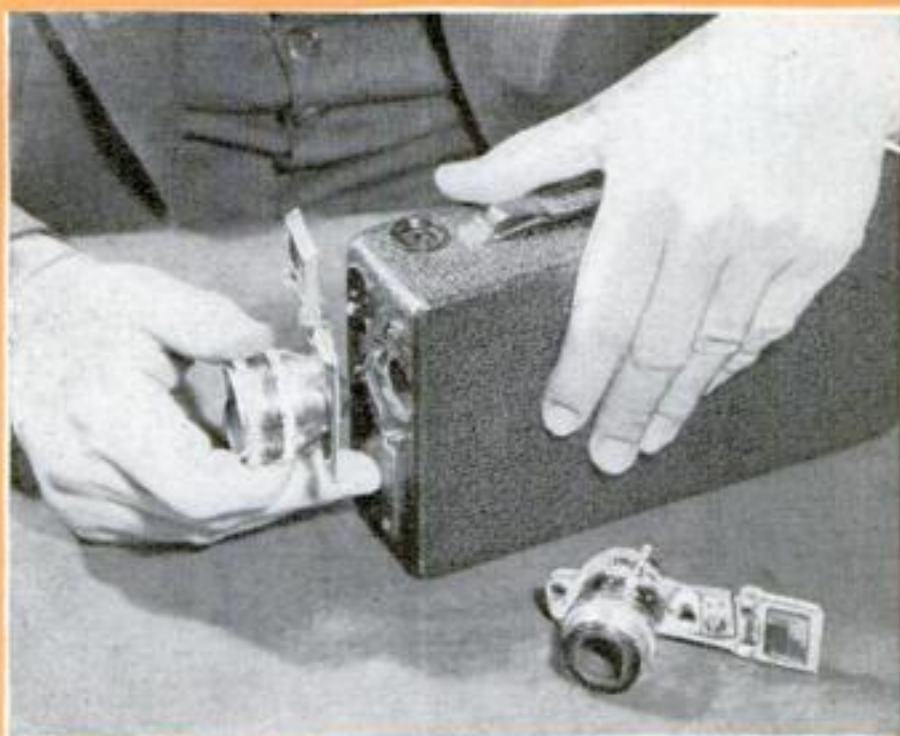
**By
ALFRED P. LANE**

a camera taking 4" by 5" pictures. From here down to the 35-mm. miniature camera, which uses a 2" lens to take a picture about 1½" wide, the angle of view taken in by the lens is from 40 to 45 deg., as shown in one of the accompanying diagrams. That is true for virtually all sizes of still cameras.

A 15-mm. lens (slightly less than ⅝") is considered the standard wide-angle lens for 16-mm. movie taking, yet this lens takes in slightly less angle of view than would be included by the lens of any ordinary still camera.

Your vacation movies will consist mainly of pictures of groups of people or single individuals engaged in various vacation activities, both long shots and close-ups, and all sorts of views of the surrounding scenery. When you consider that you have to be at least 25' away from a standing man to get him all on the film with the standard 1" movie lens and 8' away to get in just his head and shoulders, and that you'd have to be twice as far away with a 2" lens or four times as far away with a 4" lens, the disadvantages of the telephoto lens in most cases outweigh the possible advantages.

Obviously, there is no sense in backing away from a scene merely in order to use a telephoto lens. In shooting the scenes you ordinarily take on a vacation, the occasions when you cannot get within the working range of the standard 1" lens are remarkably rare. Much more often you will find that you can't get far enough away to take in all you want, and the wide-angle



The so-called "taking angles" of four types of lenses. Above, a wide-angle lens is the first extra lens to buy. In circle, a tripod insures rock-steady movies

The scene at the right would not be worth taking if the whole sky area appeared as a blank white space. That is why filters are so useful. If, however, a red filter is used, be careful not to underexpose or the result will be far from pleasant, as shown in the picture below



against a darker shade of blue.

If you are taking your movies in full color, you don't need to worry much about getting the clouds because the film will register just about what you see. However, if there is a bit of haze, the use of the proper haze filter will clear things up and get rid of the blue tinge over the whole scene.

lens will solve the problem. It will prove particularly helpful in taking movies of special places and general scenery. Often you will be able to get in the whole of a camp or cottage with the wide-angle lens where surrounding trees and shrubbery cut off the view when you try to get it with the 1" lens.

A definite disadvantage of using a telephoto lens is that it calls for the use of a tripod. If you will not bother to carry and use one, then it is well to forget about telephoto lenses. Getting even a reasonably steady picture when using a 2" lens on a hand-held camera is an impossibility for the majority of men.

Every vacation film should include plenty of interesting scenic shots, and nothing adds more to their attractiveness than a sky filled with billowy white clouds.

Here is where the wide-angle lens is a real help. Aside from getting in more of the mountains when you take a shot down the valley, and more of the foreground, it takes in more of the sky higher up where the clouds stand out in well-modeled whiteness

No other type of filter should be used.

On the other hand, if you are working with black-and-white film, filters will be necessary to get good cloud pictures. Camera stores today display a bewildering variety of shades of yellow, green, and red filters, so it is no wonder that the inexperienced movie maker becomes confused.

For use with any type of panchromatic film, either the regular speed or the extra-fast variety, you need just two filters. One should be a strong yellow, such as the Wratten G, and a red filter such as the Wratten type A.

There is no use fooling around with weak filters. When clouds are an important feature, you want them to show up strongly enough to be worth while. For all cloud effects where the clouds are clearly defined against a blue sky, the G filter will do the job. Save the red A filter for use when you wish the clouds to stand out more prominently in a slightly hazy sky and for far-distant views, particularly when there is a bit of haze in the air. Under such conditions the A filter will bring out distant details and

the clouds more clearly than you see them with your own eyes.

Don't buy cheap filters of unknown brands. A poor filter will not give you the color corrections you want, and it may also spoil the sharpness of the picture.

If you must economize, get the filters in the form of 2" squares of gelatin and mount them yourself in cardboard mounts. Handled carefully and protected when not in use, the gelatin filters may last two or three years.

Ordinarily, you will get best results in your vacation movies by using one of the

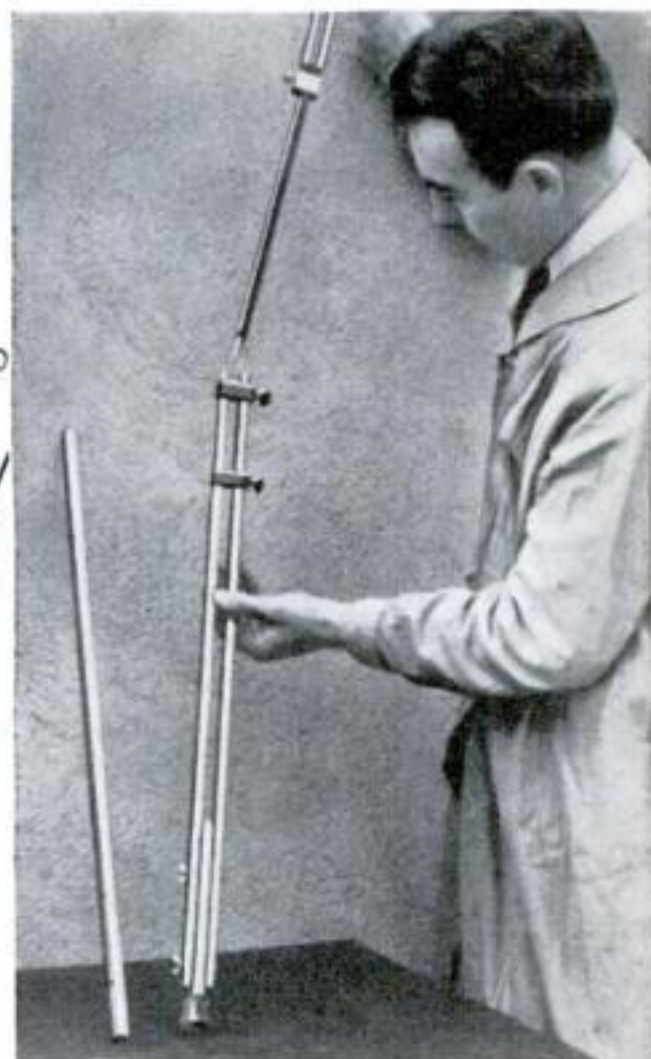
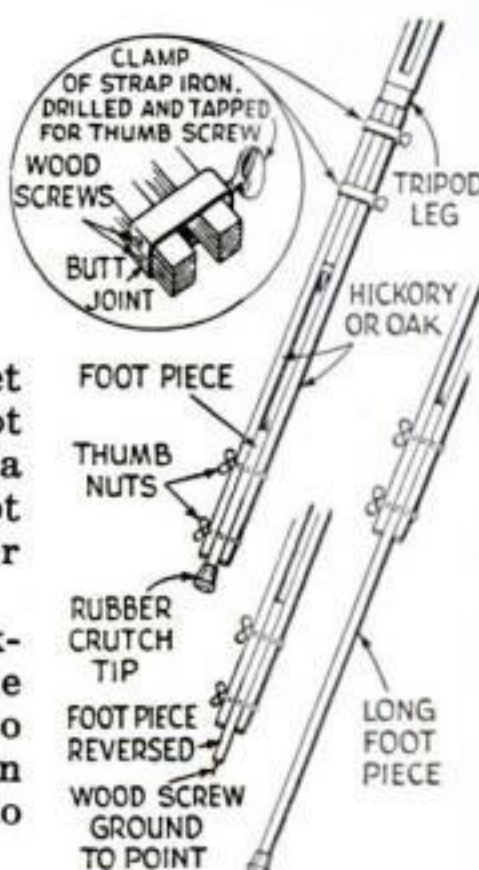
regular speed panchromatic films, but if you prefer to use the very fast film because it permits working earlier in the morning and later in the evening, the yellow and red filters will come in handy to prevent overexposure on distant shots made in brilliant sunshine, even when no sky is included in the picture area.

To insure perfect pictures, it is desirable to use an exposure meter, especially for color movies, because exposures must be exactly right for correct color rendition. At first, keep a record of the meter readings to make sure no compensation is necessary.

Adjustable Extension Legs Give Added Height to Tripod

CAMERA tripod legs can be extended several feet with extensions made as illustrated. These slip over the lower ends of the tripod legs and are locked in place by thumb screws threaded through the metal straps that serve as clamps. Either metal-pointed or rubber-cushioned feet are available by reversing the foot pieces. Where extreme camera height is desired, the short foot pieces can be replaced by longer ones.

It is a good idea to cut the extensions and long foot pieces to the length of the tripod when folded so all may be carried conveniently in a bundle. Finish the extensions to match the tripod.—J. M.



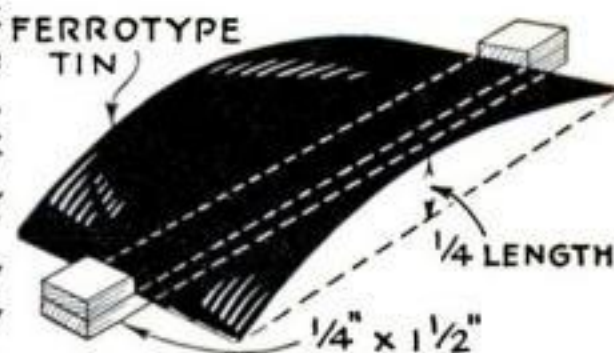
Preparing Opaque Cloth to Use for Bellows

OPAQUE, matte-finish cloth for making experimental or substitute bellows for cameras and enlargers, and for bellows repairs, can be prepared by coating one side of black sateen or similar cloth with well-stirred, flat black paint. White cloth has been shown above, but only for the sake of clearness.

Glossy Prints Dry Evenly on Curved Ferrotypes

IF GLOSSY prints are dried on ferrotypes plates held in an arched position, I find that they will peel with little or no curling and will be free from "oyster-shelling," as the oval creases formed by uneven drying are sometimes called.

A convenient accessory for flexing the ferrotypes plate is a strip of wood with small cleats nailed or screwed to the ends as illustrated in the sketch below. The ends of the plate are sprung between the cleats so it is arched to a height equal to about one fourth its length. The original rack was made from a strip of wood $\frac{1}{4}$ " by $1\frac{1}{2}$ ", but any scrap lumber may be used.—L. K.





Pocket-Size Flash Light Reveals Leaks in Camera

THE accepted method of searching for light leaks in a camera is to insert an electric bulb into it, but a better method, especially with small cameras, is to use a pocket-size flash light as shown.—L. H.

• • •

YOU'LL save time by working systematically when developing. Always place the trays in the following order from left to right: developer, rinse water or stop bath, and fixing bath. Avoid contaminating developer with hypo on fingers.

Fluids Stored in Graduated Drug Bottles

GRADUATED medicine bottles with composition screw caps, which are often used by druggists when filling prescriptions, are excellent for

photo solutions. One can pour out the required amount from them without the use of a separate graduate. The composition screw caps cannot rust, and the mouth of each bottle is grooved to facilitate pouring. Prices range from 10 to 20 cents each.—A. T.



Developing Two Rolls in Tank

TO DEVELOP two rolls of film at one time in an ordinary reel, place the rolls together back to back without removing the backing paper. Cut away the excess paper from the free end and use cellulose tape to join the two strips of film, with the backing paper between.—K. M.

FILTER TIPS

[PHOTOGRAPHY]

For a sky filter to register clouds, a light to medium yellow filter is all that is required with orthochromatic film. When in doubt as to how a scene will photograph on orthochromatic film, view it through a blue filter. A special viewing filter prepared to approximate panchromatic results may be used with panchromatic film; it will help in deciding what color contrasts need emphasizing, and you can then select the filter for that purpose.

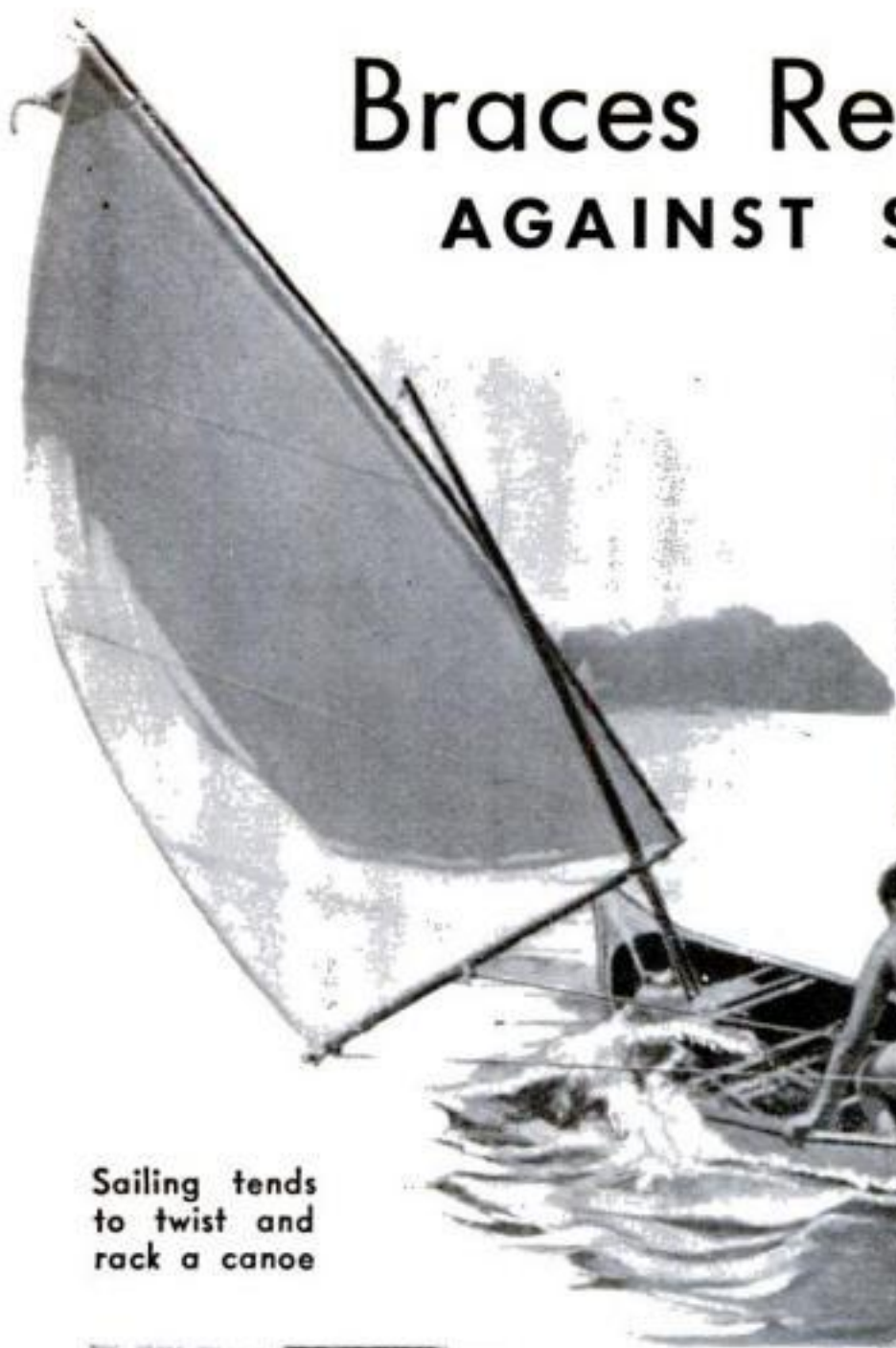
A yellow filter will emphasize snow shadows, since they contain blue. A red filter will give a very dark sky and brilliant clouds, but use only with red-sensitive films such as panchromatic and infra-red. Remember that the filter factor varies with type of film and illumination used. Where true color rendition is of minor importance and extreme sharpness is desired outdoors, use a "close cutting" filter such as Wratten A or F (red). Never use a filter over an exposure meter. Compute the exposure from the data given with the film and the normal reading.

Blueprints copied through a red filter will give a black background with white lines. Care for your filters as you would for a good lens. A light yellow filter used on the enlarger for unusually weak negatives will give improved results.

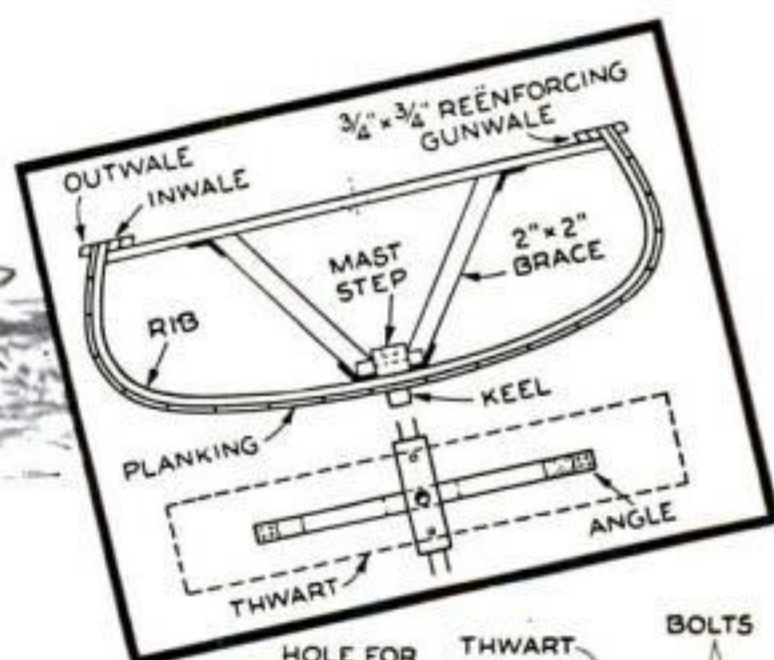
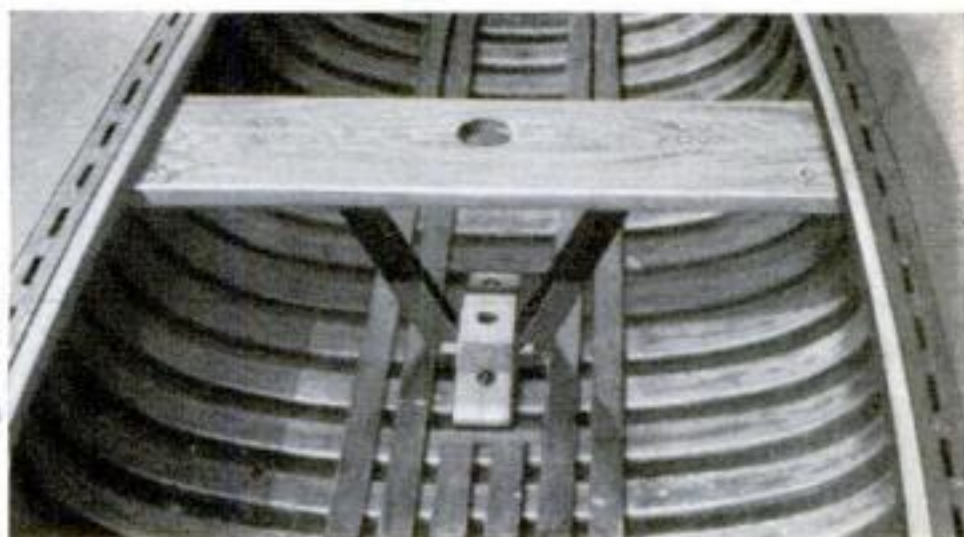
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Braces Reënforce Canoe

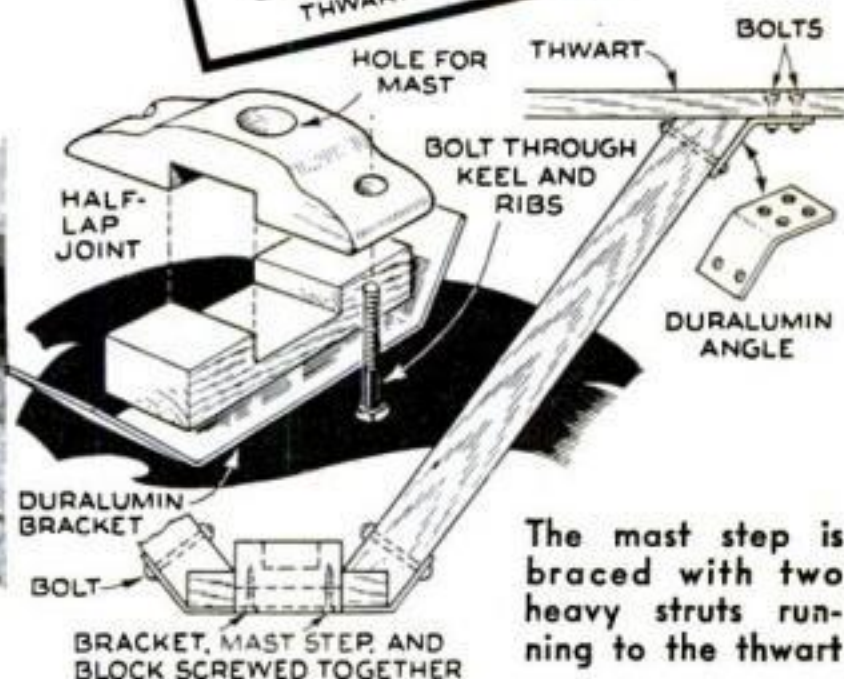
AGAINST SAILING STRAINS



Sailing tends to twist and rack a canoe



Strips of mahogany are securely fastened with long screws to strengthen the gunwales from deck to deck



The mast step is braced with two heavy struts running to the thwart

SPLIT gunwales and a leaky, twisted hull are the result of sailing an unbraced canoe, especially in winds strong enough to keep one or two men constantly on the windward gunwale. A V-brace at the mast step and extra gunwale braces will give an ordinary canoe the added strength it needs for sailing.

Two $\frac{3}{4}$ " by $\frac{3}{4}$ " mahogany strips, long enough to reach from the bow deck to the stern deck, are used to strengthen the gunwales. One strip is attached to each inwale with screws long enough to pass through inwale and ribs. Use a screw at

every other rib. An assistant or clamps will be necessary to hold the strip.

The mast step is fastened to a block of wood with a half-lap joint as shown, and they are screwed together with a strip of $\frac{1}{16}$ " thick duralumin underneath. Bolt this assembly into the canoe with two bolts running through the keel and ribs. Connect two wood braces, about 2" by 2" oak or ash, to the mast step assembly and to the mast thwart by using sheet-duralumin brackets.

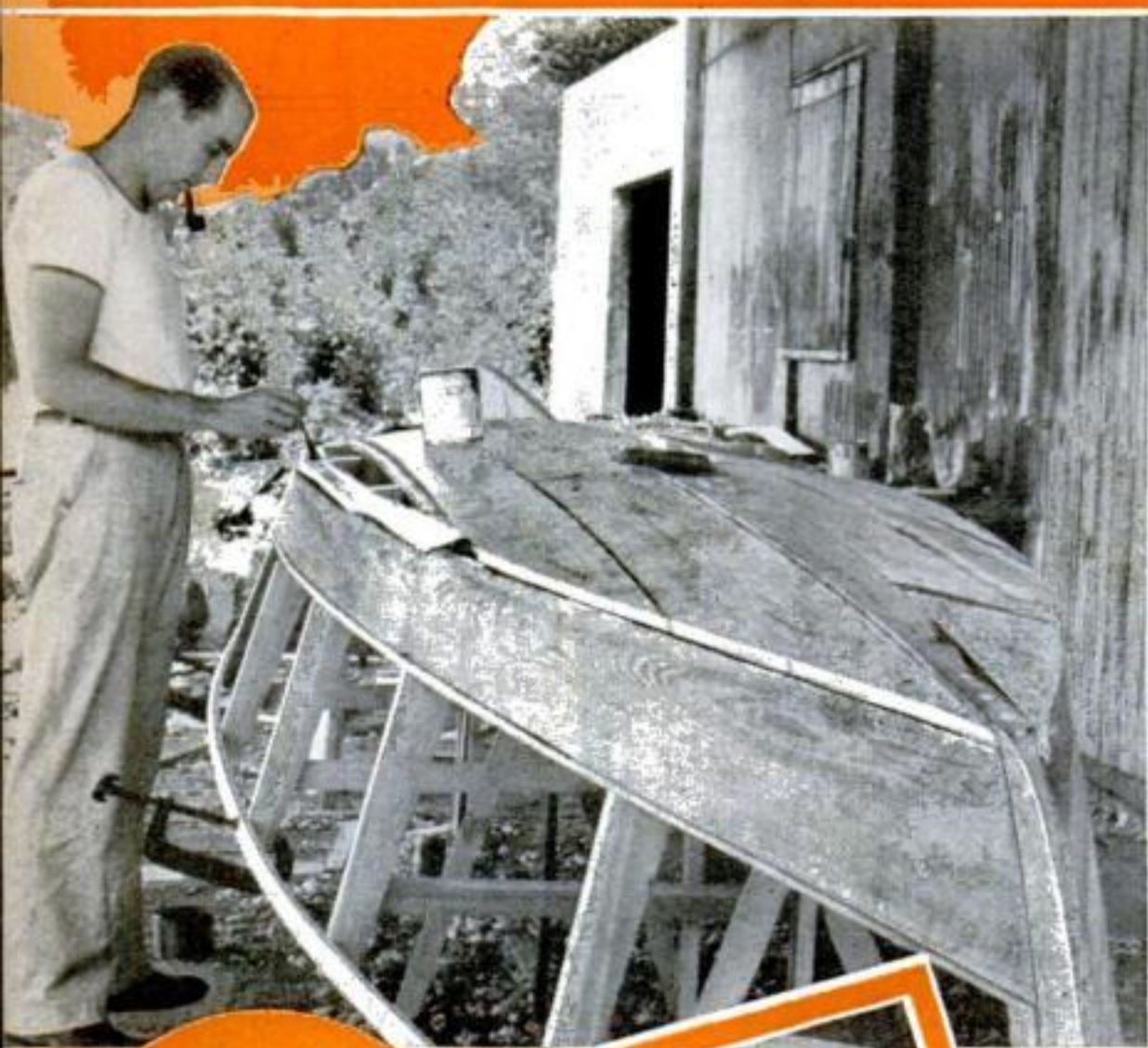
The extra gunwales and the V-brace should be well sanded and given three coats of spar varnish.—WALTER GOTTLIEB.

WE PLANK AND FINISH OUR ECONOMICAL NEW

Inboard

PART TWO

By BRUCE and WILLARD
CRANDALL



Before a plank is fastened, the joints, if below the water line, are made water-proof by using marine glue and strips of cloth



Above, the propeller is set several inches back of the stuffing box. An iron shoe is fastened to the skeg to guard propeller and rudder

Rudder

2"
SQUARES



1/4" GALVANIZED
IRON DOWELS

THE next step in building *Waltonian* is to true up the entire framework and bevel the chines, frames, and transom so the planking will fit perfectly. If batten-seam construction is to be used, put on the battens as the planks are fitted. Do not cut batten notches in the transom planking. Before starting the planking, cut notches in each frame next to the keelson to facilitate bailing.

Begin with the bottom side planks. These and the top side planks should be made from 8" widths, and 8" widths are also used for the garboard planks and the outside bottom planks. After the bottom side planks are in place, dress them down flush with the chines; the bottom planks will then lap over them. It will improve the looks of the side planking if all of the planks are tapered slightly toward the stern.



Motor Boat 'Waltonian'

To fit the garboard plank against the keel, clamp it in position and then mark along the edge to be fitted with a pencil compass. The plank is cut and planed to shape and then clamped in position for the final fitting. The seams of the bottom planks should be left open about $1/16$ " to allow for swelling.

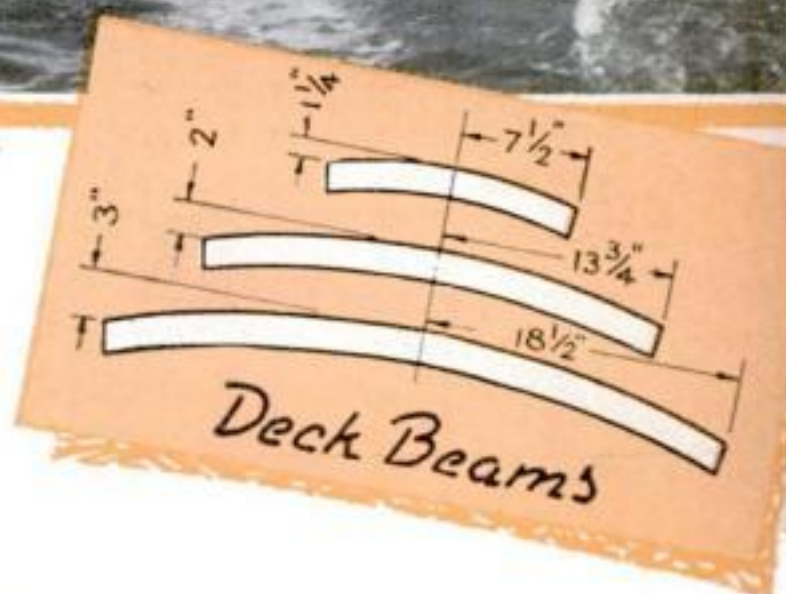
Just before fastening each plank, coat with marine glue all joints that need to be waterproof. Then lay a strip of cotton flannelette over the glued surface and coat the cloth with glue. This is not necessary for seams above the water line.

Fasten the planks with flathead screws, $1\frac{1}{4}$ " No. 8, or larger where necessary, countersinking the screws enough to allow for covering later with putty or special composition. They should be spaced not over 1" apart where driven into the transom, transom frame, and stem, and $1\frac{1}{2}$ " to 2" apart along the keelson and chines and into the frames. The planks may be fastened to the battens with $1\frac{1}{4}$ " galvanized nails, copper rivets, or $\frac{3}{4}$ " No. 7 screws spaced about 2" apart. If nails are used, they should be well clinched. Should screws be used, the battens should be of oak or some wood that will hold screws well.

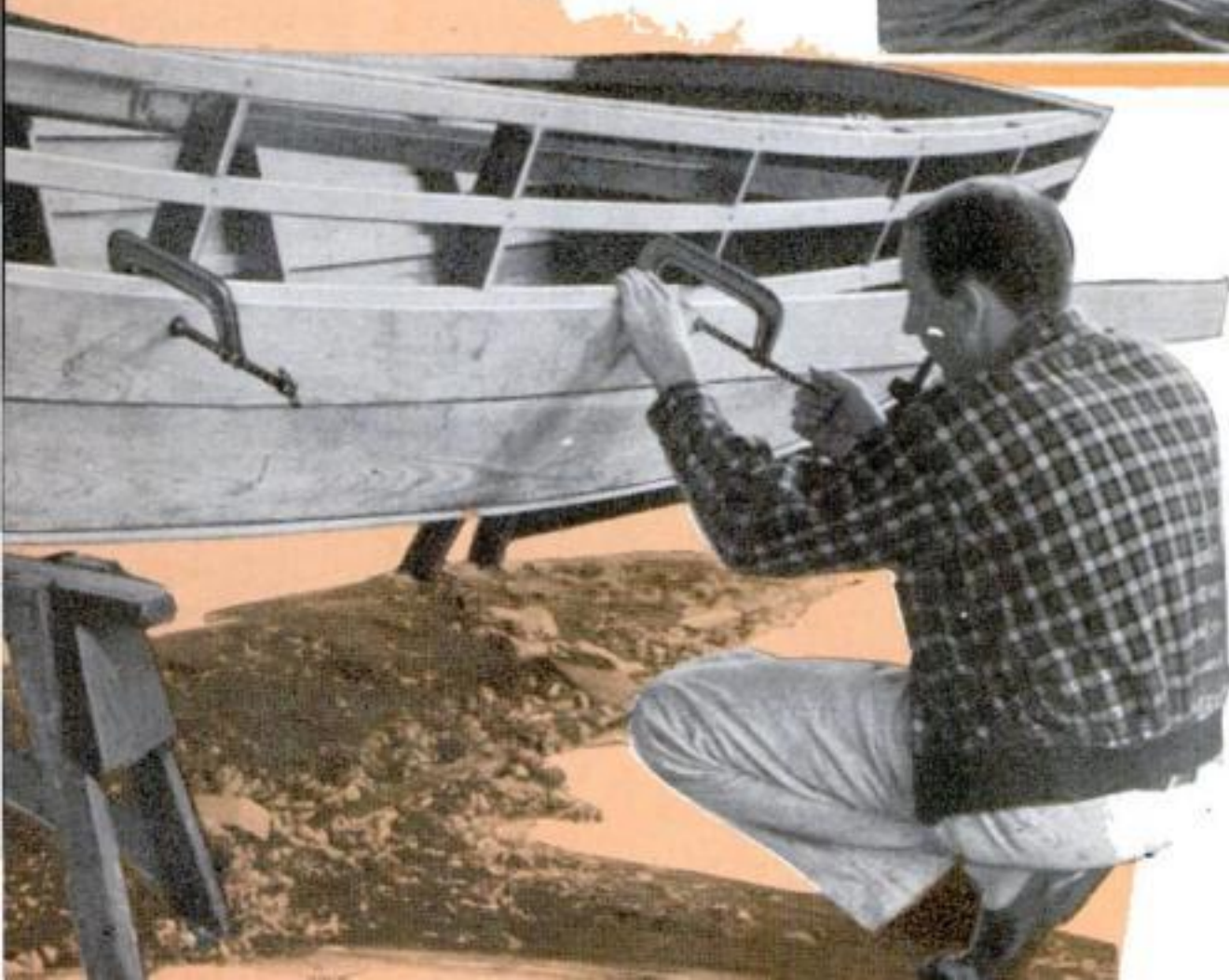
It improves the looks if all the side planks are fitted to taper slightly toward the stern

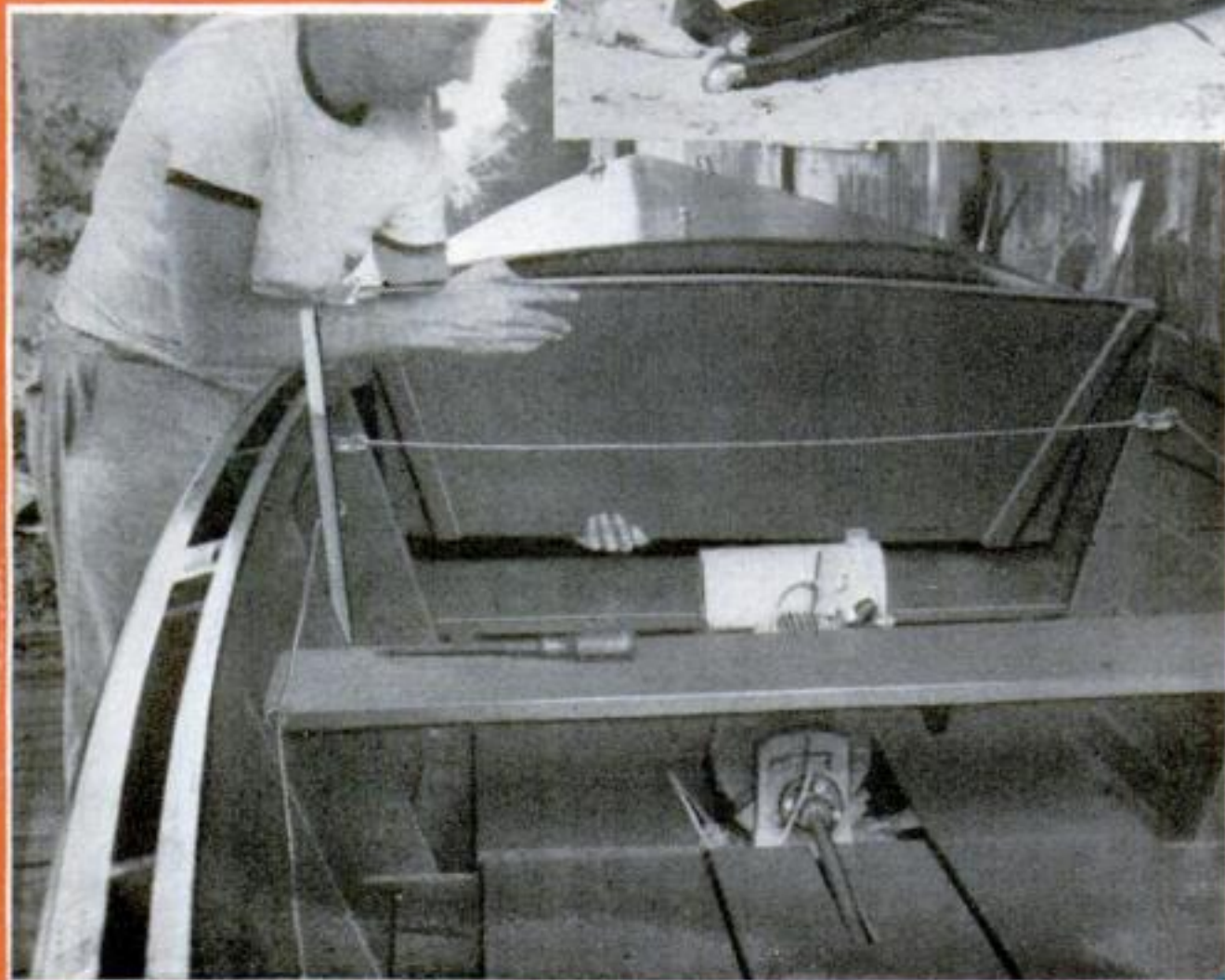
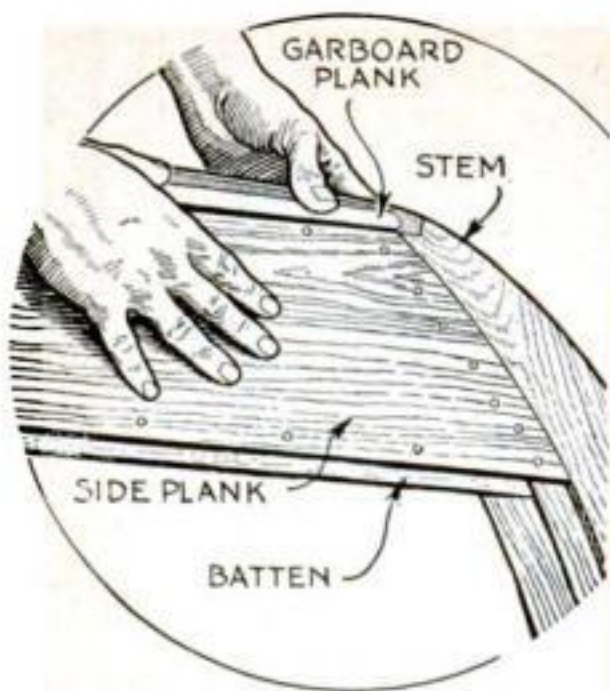
In cases where waterproof plywood $\frac{3}{8}$ " or thicker is substituted for planking, the battens may be eliminated. The plywood should be put on in full-length panels with no splicing, if possible. Should a splice be necessary, it is made diagonally and the seam backed with about a 10" width of the same material. The joining surfaces must be coated with marine glue and fastened with plenty of copper rivets.

Exact dimensions cannot be given for the skeg, but it should be laid out in such a way that the propeller will clear the keel



The deck beams and, above, a photo of the boat under way. Note how roomy it is for its length of 15'





The boat is light and can easily be carried on a small trailer. At left, an interior view showing the air-cooled $\frac{3}{4}$ -h.p. motor

be streamlined as much as possible at the aft end.

The skeg is fastened to the keel and keelson with $2\frac{1}{2}$ " No. 12 screws and 4" lag screws. The joint between the skeg and the keel must be made absolutely water-tight by the use of

by at least 1". It is best to make a full-size drawing, profile view, of the boat from the transom to station 3 showing the skeg, keel, keelson, and engine beds. The height and angle of the motor beds will depend on the motor to be used. From this drawing can be determined the exact angle at which to bore the hole through the skeg for the shaft.

To eliminate the danger of boring the shaft hole incorrectly, the skeg may be made of two 1" pieces as shown in one of the drawings, and half of the hole for the shaft chiseled out of each piece. These two pieces are then fastened together with bolts and screws after the surfaces have been coated with marine glue. Once the skeg is in place, the hole can be continued by boring through the keel and keelson, using the hole in the skeg as a guide. The skeg should

a cloth gasket and plenty of marine glue, unless an inside stuffing box and shaft log are used, in which case the shaft log is made water-tight to the keelson in the **same** manner. After the boat is removed from the form and turned right side up, the engine beds can be installed. They are fastened to bottom frames Nos. 3 and 4 with lag screws. If the motor is as large as 3 to 5 h.p., the bottom frames 3 and 4 should be specially reinforced and braced to the side frames. The motor is fastened to the engine beds with lag screws and then carefully trued up.

When the side planking is completed, the sheer line should be trued up with care. The deck beams may be installed as shown in the drawings. Next, the entire inside of the hull should be painted. The inwales are

BENDING PLYWOOD

[WOODWORKING]

To bend limited curves, fasten the panel at one end and gradually bend the plywood around a template.

Sharper curves may be obtained by saw-kerfing the back of the plywood at intervals. The spacing of the kerfs is determined by the sharpness of the curve desired.

Resin-bonded plywood can be bent after the panel has been soaked or steamed. The time for steaming is double that required for an equal thickness of lumber.

Minimum radii to which plywood can be bent:

Panel thickness	$\frac{1}{8}$ "	$\frac{1}{4}$ "	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{5}{8}$ "	$\frac{3}{4}$ "
Smallest radius if bent lengthwise	15"	24"	54"	8'	10'	12'
Smallest radius if bent crosswise	8"	15"	36"	6'	8'	10'

POPULAR SCIENCE MONTHLY SHOP DATA FILE

notched somewhat into the side frames. The deck, seats, and flooring can be arranged in any way desired. The use of waterproof plywood for seats, decking, and floor will prove entirely satisfactory and will decrease the total weight considerably.

The rudder should be made essentially as shown and fastened with rudder gudgeons, or screw-eye bolts, and a galvanized rod or 12" bolt. The steering ropes and pulleys may be eliminated if desired, and the boat steered by a longer tiller arm.

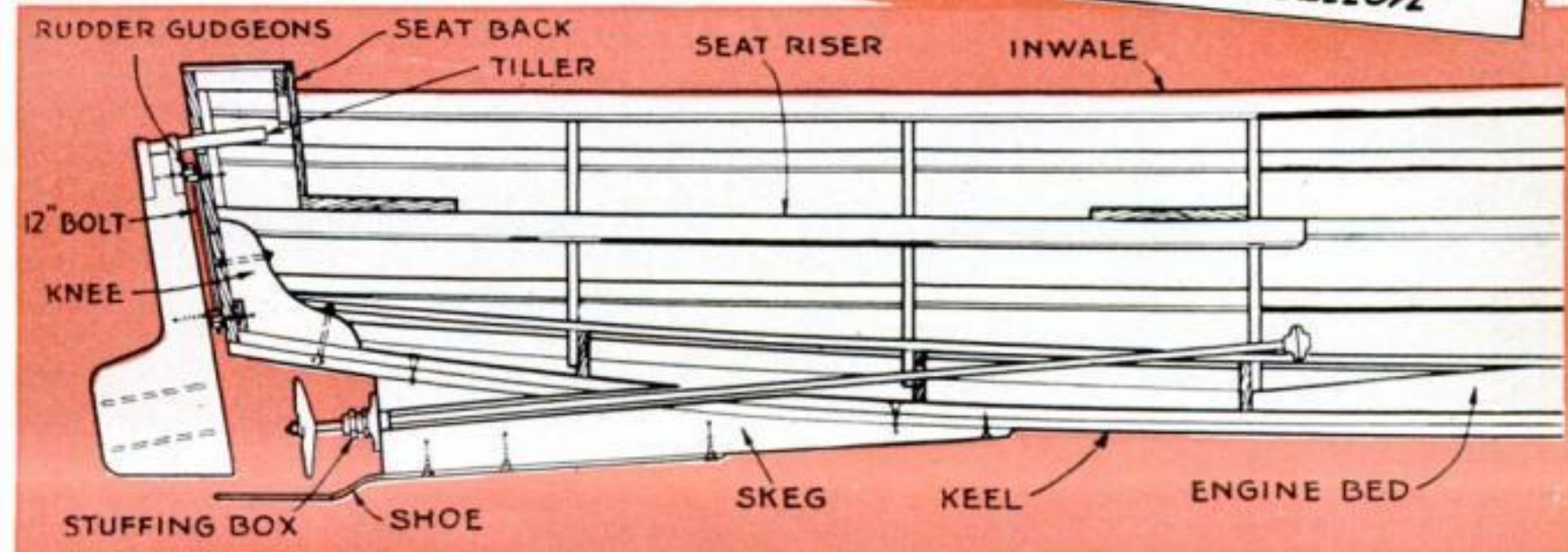
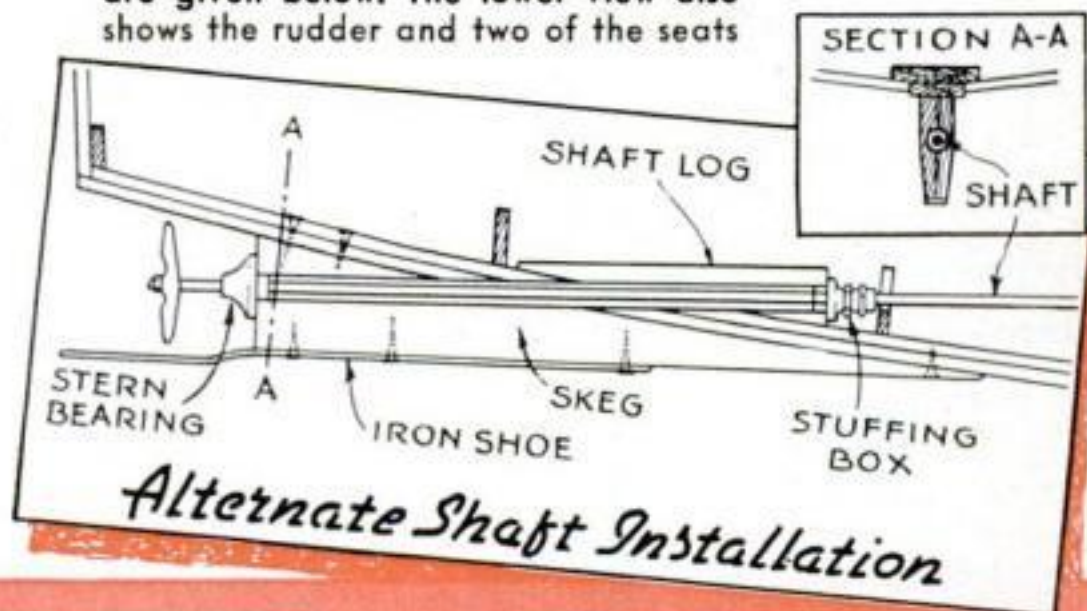
Unless plywood is used for planking, the entire outside of the hull should be well sanded before painting. Apply at least three coats of marine paint. Spar varnish may be used for the deck, seats, and trim.

The half-round molding should be put on carefully to insure a

perfect curve fore-and-aft to the sheer line. The stem should be protected by a strip of half-oval galvanized iron or brass, and the propeller can be protected by the use of an iron shoe. Other fittings are optional and may be arranged as desired.

Recommendations for the size of the propeller may be obtained from the manufacturer of the motor.

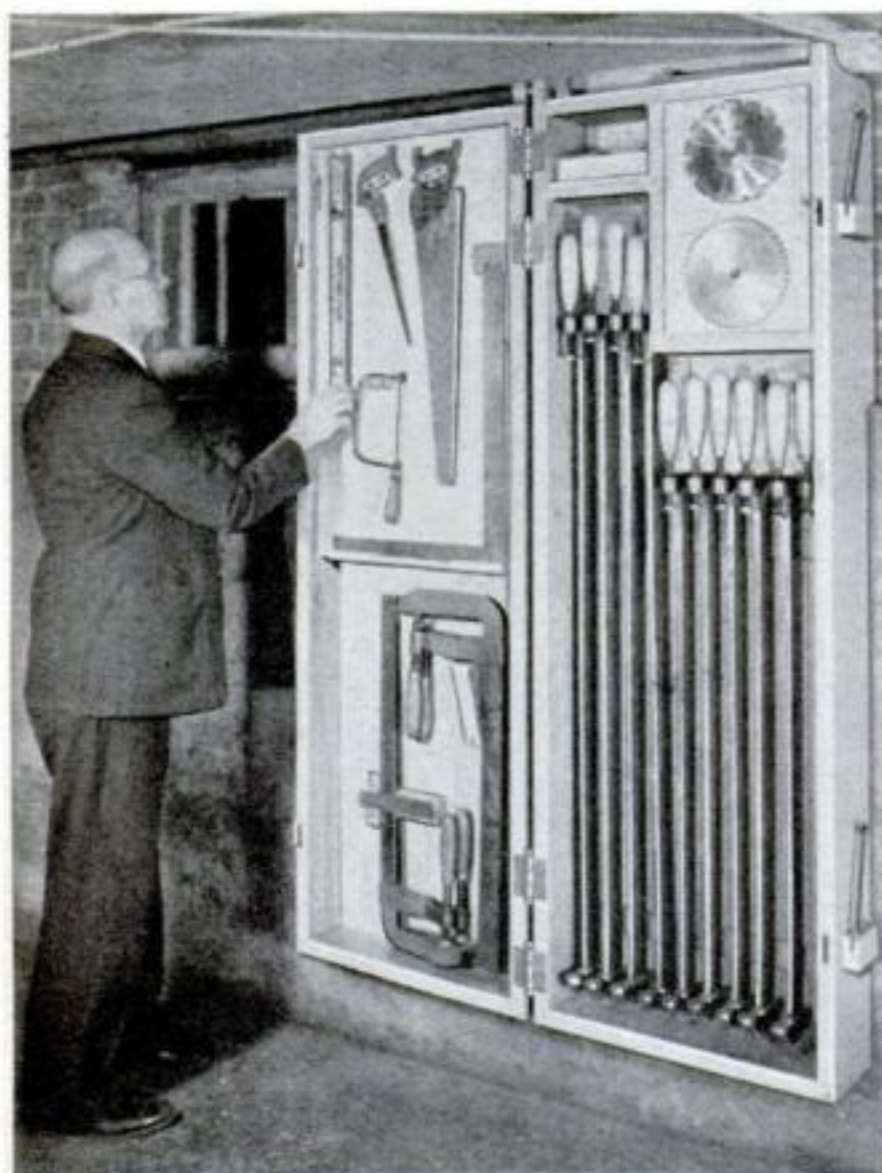
Two methods of installing the shaft are given below. The lower view also shows the rudder and two of the seats



In this wall cabinet, the butt chisels and screw drivers are arranged on sliding panels. Twist drills, countersinks, and the like are kept in a removable block. Below, a chest for seldom-used tools



HEAVY-DUTY Tool Cabinets FOR THE HOME SHOP

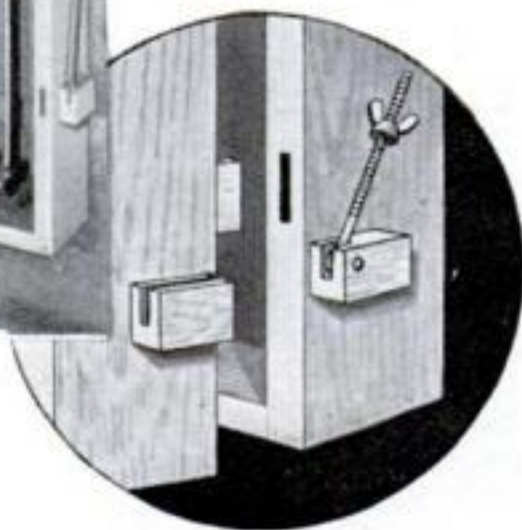


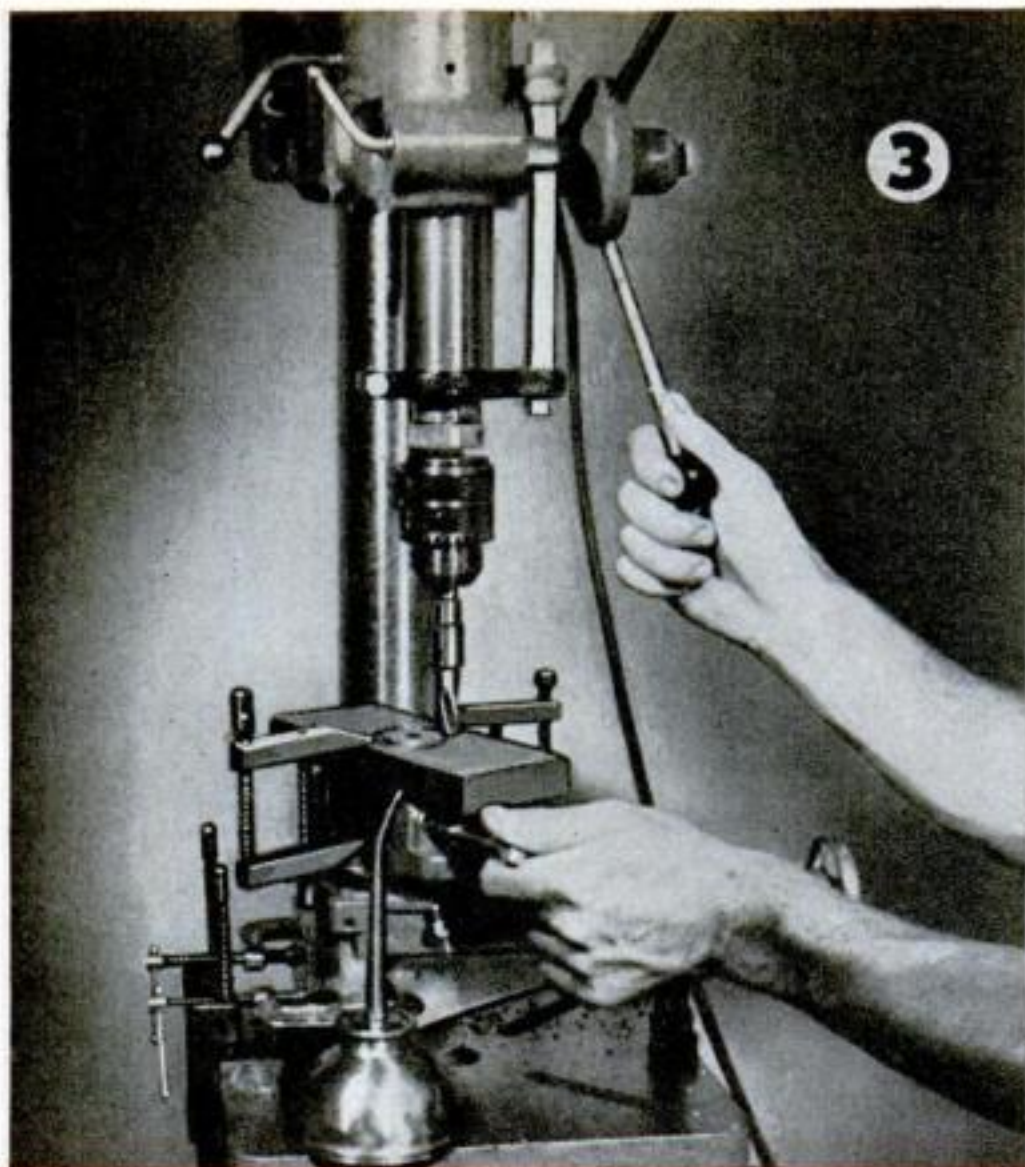
Behind the two tool panels at the top of this cabinet are shelves for special tools. Right, the method of fastening

THE dyed-in-the-wool home worker usually inhabits the underground region, sometimes called a basement, from which he emerges only for such uninteresting necessities as food, sleep, and earning a living. In the basement, however, he is often forced to contend with moisture from the family wash and dust from the furnace, and it is therefore desirable to construct good tool cabinets.

No two hobbyists would have identical cabinets, so the accompanying photos of the writer's equipment are given merely to illustrate the general idea. The cabinets are made of $1\frac{1}{8}$ " white oak and ash with $\frac{3}{4}$ " fir plywood backs. Tapered tenons are used to relieve the load on the hinges when the cases are closed. For holding the cabinet closed, bolts with thumb nuts are used, working in slotted blocks so that closure is tight enough to exclude dirt and most moisture.

Tool chests are useful for storing tools seldom used, and one is illustrated, but cabinets are more readily accessible.—H. C. KEYSOR.





The work is clamped to an adapter block, which is held in the milling-attachment vise. The circular slot is then milled

with a cross-test level and make any necessary adjustments. Now place an improvised plug gauge in the drill chuck and use it to center the pivoting point of the vise slide accurately. Replace the vise and align hole A with a corresponding plug held in the chuck.

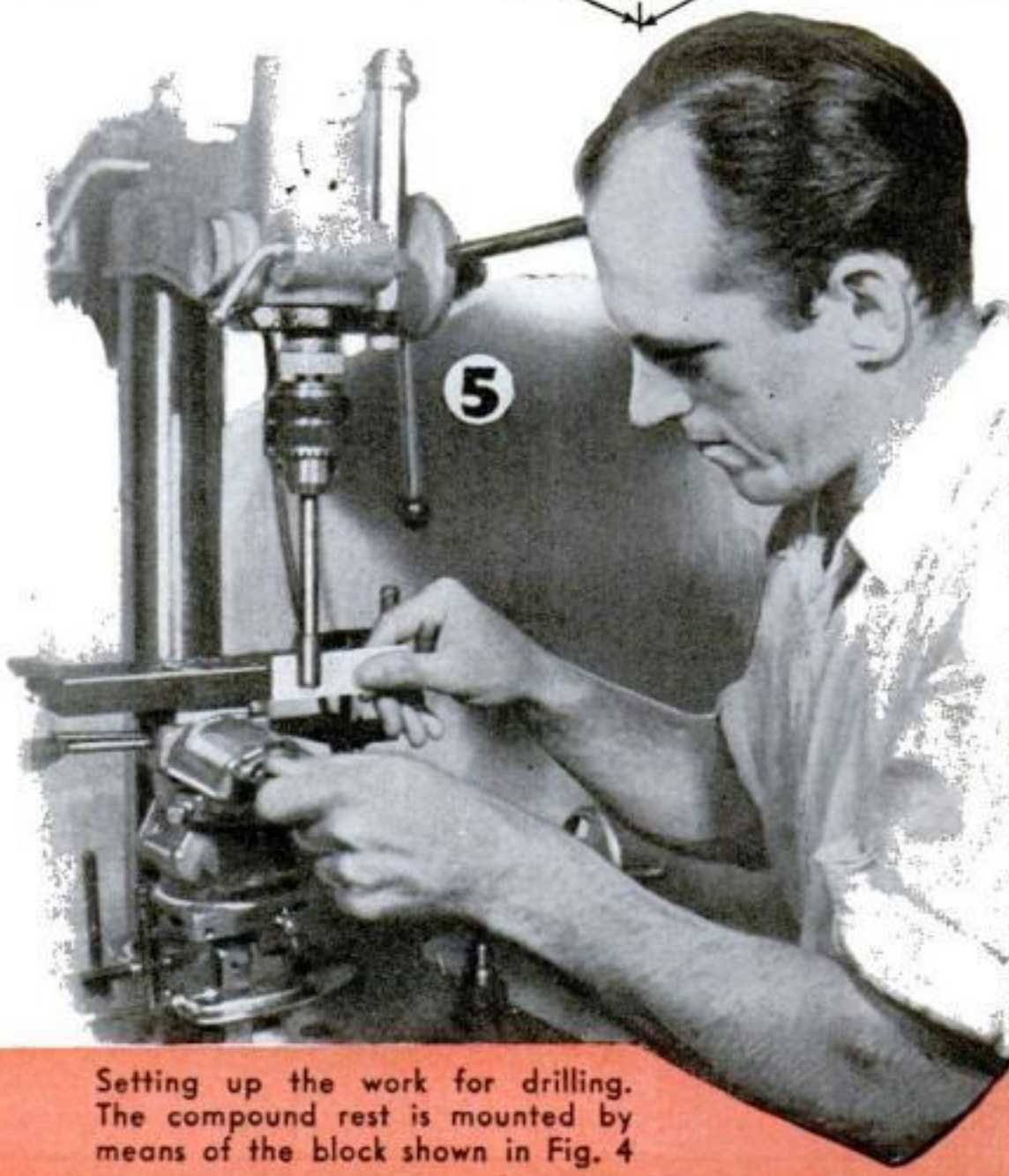
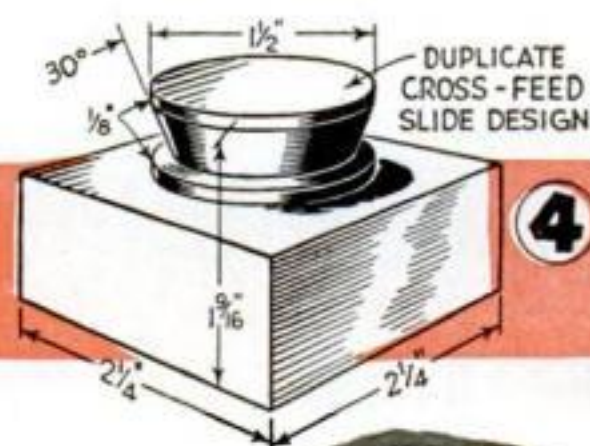
The work is then clamped securely to an adapter block, which is in turn held in the vise, and the circular slot is milled as in Fig. 3. The slot is started with a hole. The end mill is fitted to a straight-shank adapter, and washers should be used with the locking screws of the vise component so as to obtain a precise but free circular movement.

Now an adapter must be made as in Fig. 4 to enable the lathe compound rest to be installed on the lathe milling attachment so as to obtain the necessary trav-

erse movement for drilling the various holes.

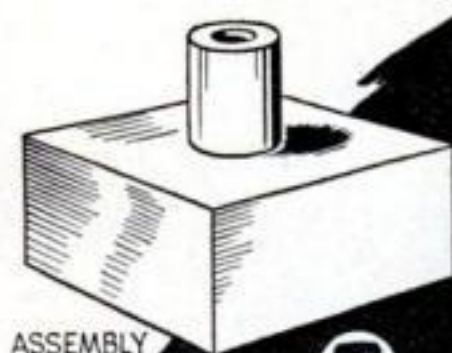
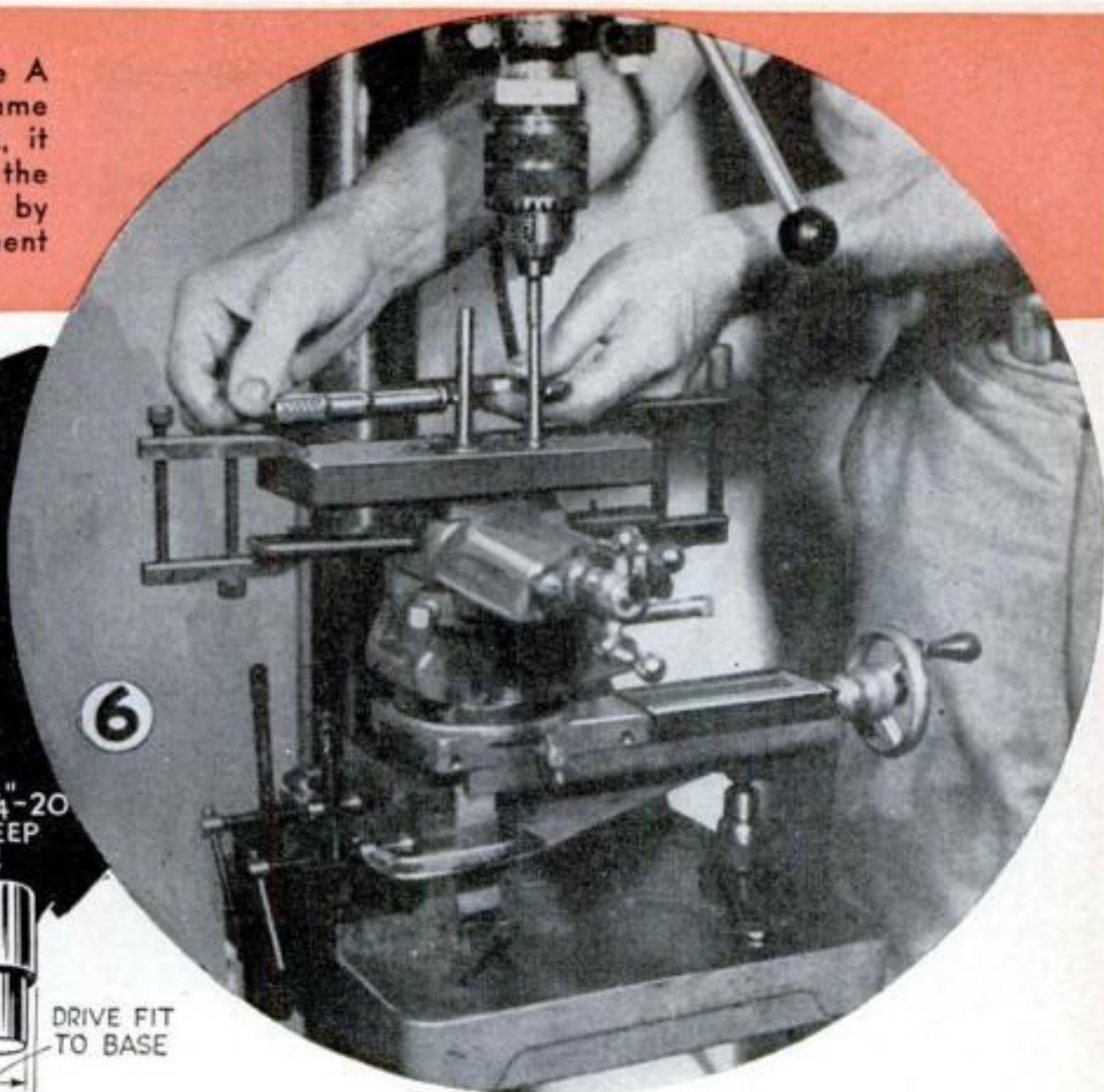
The compound rest is set up as in Fig. 5, and the work is aligned with the traverse movement by using 0.001" thick paper and making gradual adjustments until both ends show identical reading on the graduated lathe compound rest when the sides of the work and the plug gauge in the chuck are in contact with the paper.

A plug gauge is placed in hole A, and another gauge of the same diameter is held in the drill chuck as in Fig. 6. You can then quickly obtain the exact spacing for hole B with the traverse movement. You must, of course, add one gauge diameter to compute the micrometer reading. Hole C is located in relation to hole B by the movement of

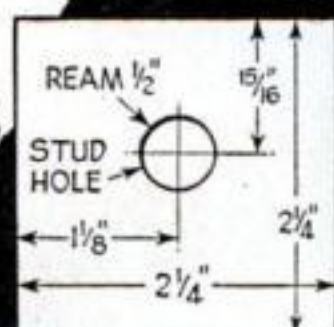


Setting up the work for drilling. The compound rest is mounted by means of the block shown in Fig. 4

With a plug gauge in hole A and another gauge of the same diameter in the drill chuck, it is a simple matter to find the exact distance for hole B by using the traverse movement



7

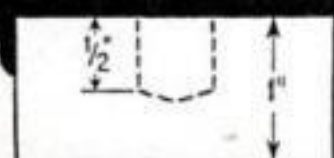


TAP $\frac{1}{4}$ "-20
 $\frac{1}{2}$ " DEEP



DRIVE FIT
TO BASE

STUD



BASE

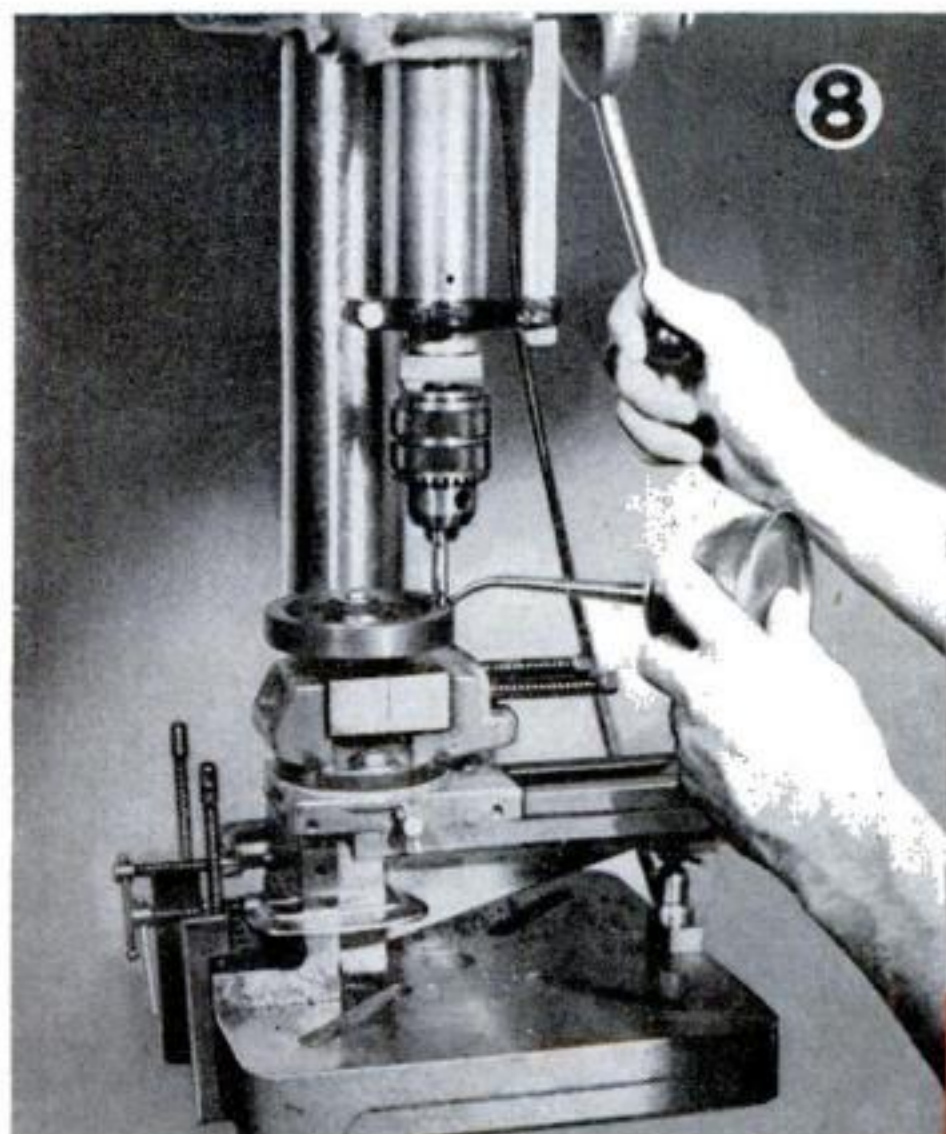
the compound rest. Hole D is made next, and the cycle is repeated in the opposite direction for the remaining three holes. Remove backlash in both planes when changing the direction of travel.

To drill holes in an index plate or similar part, locate the pivoting point as in Fig. 2, and make an adapter block as in Fig. 7. Note that in making this adapter the stud hole must be finished in the fixed position and in line with the set-up of Fig. 2.

The work is center-drilled and then drilled to fit on the stud of the adapter block. This block is mounted in the vise as in Fig. 8, and moved transversely to obtain the desired circle for the index holes. If greater precision is required than given by the dial, use a magnifying glass to split the 360 degrees. A center drill should precede the finishing drill.

Using Short Welding Rods

A WELDING rod that becomes too short for the electrode to handle can be welded to the end of a new rod when the latter is inserted in the electrode. If the short rods are attached to new rods at different angles, they will enable the welder to get at awkward places more easily.



8

Drilling accurately spaced holes in a circular part. The work is mounted on an adapter made as shown in Fig. 7

Turret ATTACHMENT

FOR A SMALL LATHE



By
C. WARREN WOODSON

SO ADVANTAGEOUS is the turret lathe in rapid production that many engine lathes are now equipped with turrets. The object of the turret is to bring a succession of different tools to work on bar stock, which is usually passed through the headstock spindle of the lathe and held with a collet or other form of chuck.

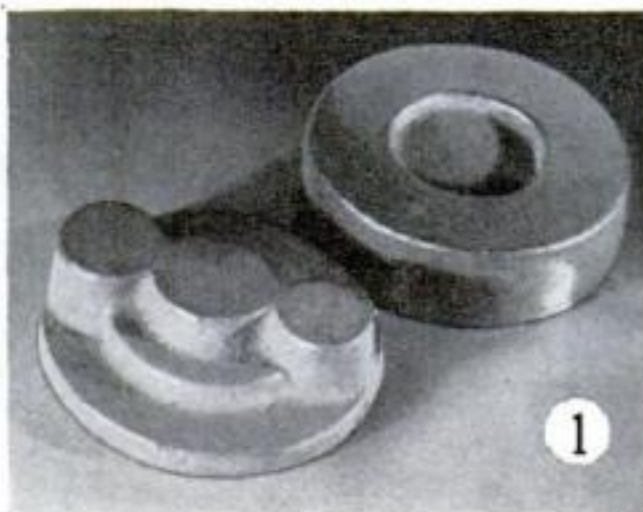
A large variety of turrets can be had to fit practically any type of lathe, but for the small shop with a small

lathe, the little tail-stock turret attachment illustrated will be found about the easiest type to construct. It is highly efficient in the rapid production of small duplicate parts.

The attachment is



Finished parts before assembly and, above, the turret ready to be used



1

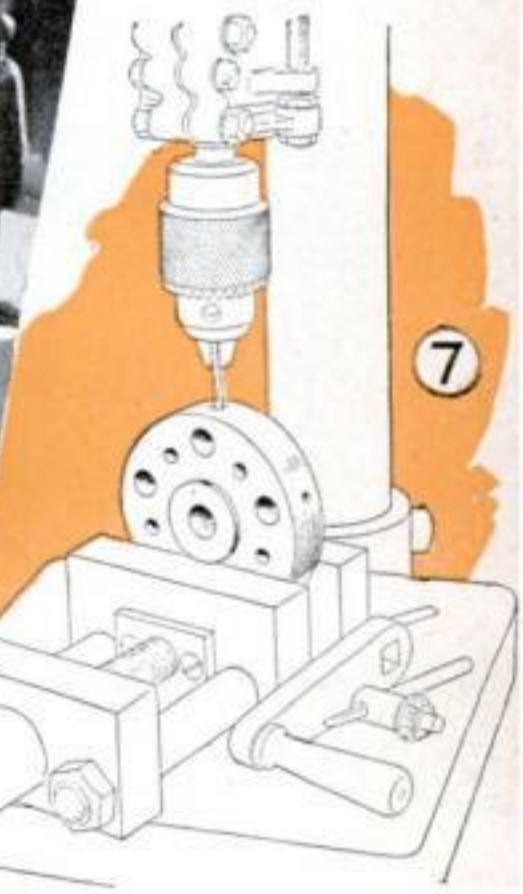
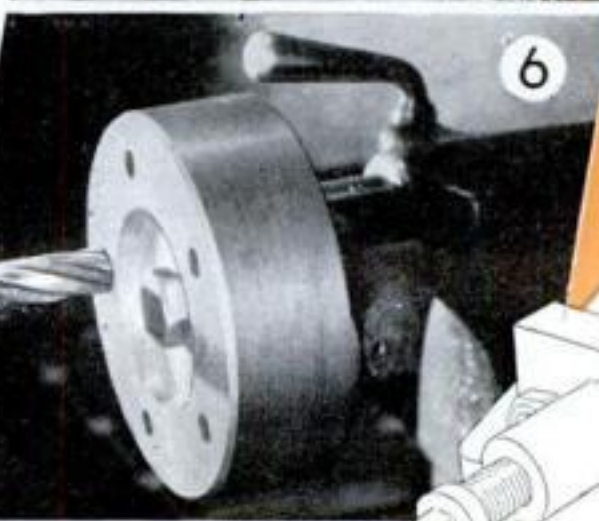
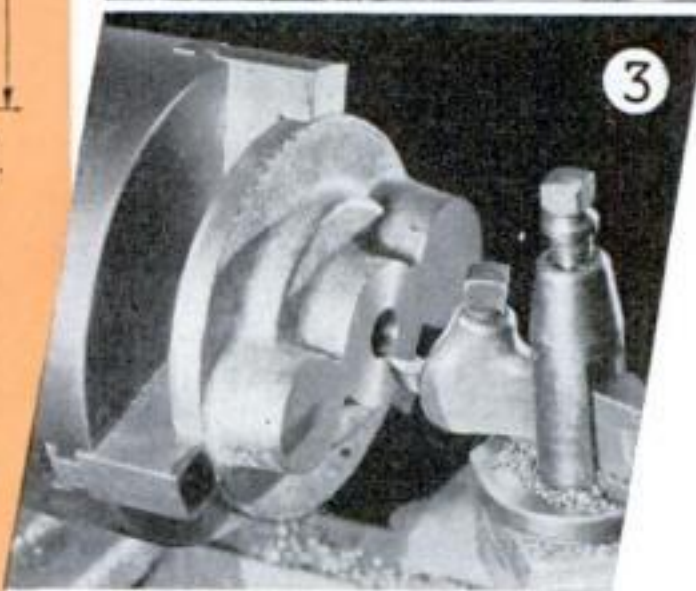
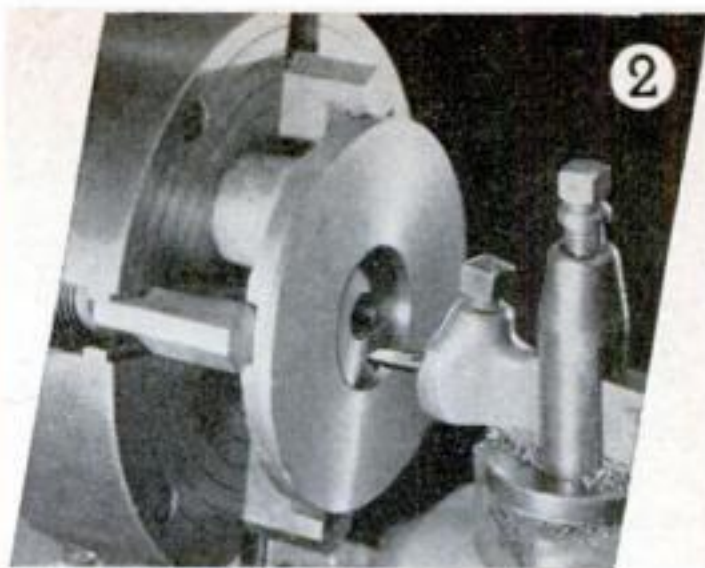


Figure 5 shows the turret head being machined to fit the base casting. While in this position, a fine circle is scribed, and the five holes for the indexing pin are accurately

laid out with the dividing head. When these holes have been drilled, the kingbolt, bar clamp, and indexing pin are made up, and the attachment is assembled and mounted in the tailstock spindle as in Fig. 6, where the tool holes are bored. These holes are started with a small drill while the turret head is held accurately in place with the indexing pin. The holes are then brought to proper size with a larger drill and reamer. Holes are next drilled in the periphery of the turret head as in Fig. 7 and tapped for safety set screws, which firmly fasten the tools and holders in place (Fig. 8).

The kingbolt used in this particular attachment was a chrome-plated bolt taken

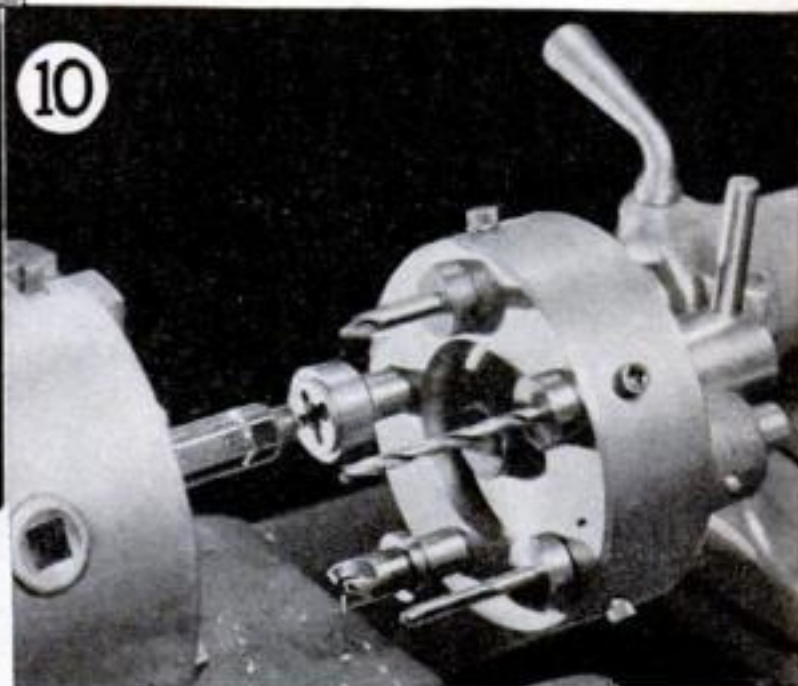
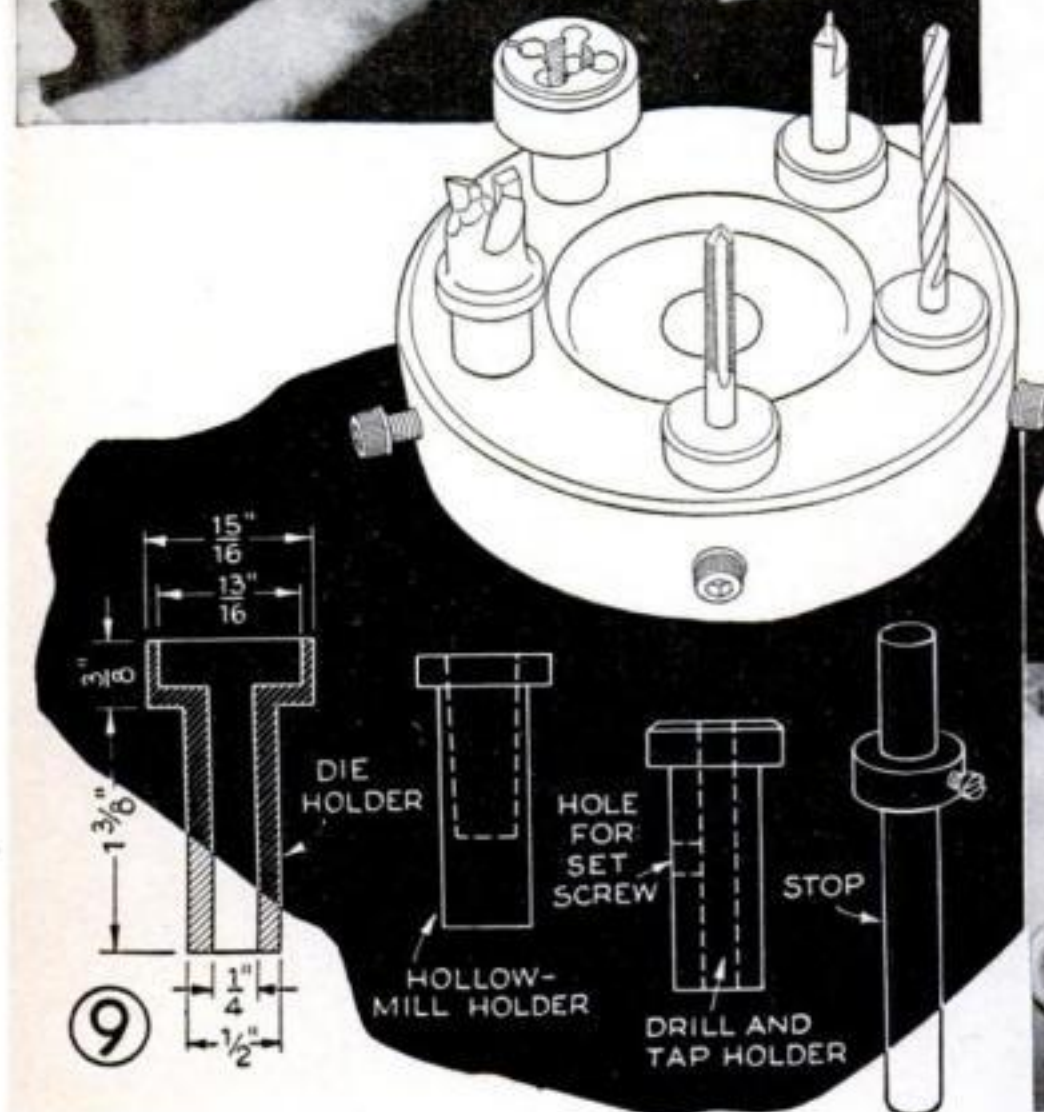
from a high-priced car. The dimensions of this part are shown in one of the drawings, but can be easily changed to those of a regular cap screw obtainable at hardware stores. The only other change necessary would be a larger bolt hole in the center of the base casting.

The indexing pin is a short piece of rod grooved as in the detail drawing for a retaining screw. A hole for the screw is drilled and tapped in the side of the base casting. If the groove in the pin is made longer, a light spring can be wound around in the groove and made to exert pressure to hold the pin securely in the index hole. The attachment works well without it but, no doubt, this improvement would be regarded desirable by many machinists.

The tool holders, Fig. 9, are made up from cold-rolled steel rod with one end turned down to fit the turret-head holes. A quantity of these holders can be prepared in advance and drilled as needed to fit the various tools to be used on each job, such as drills, counterbores, taps and dies, and hollow mills.

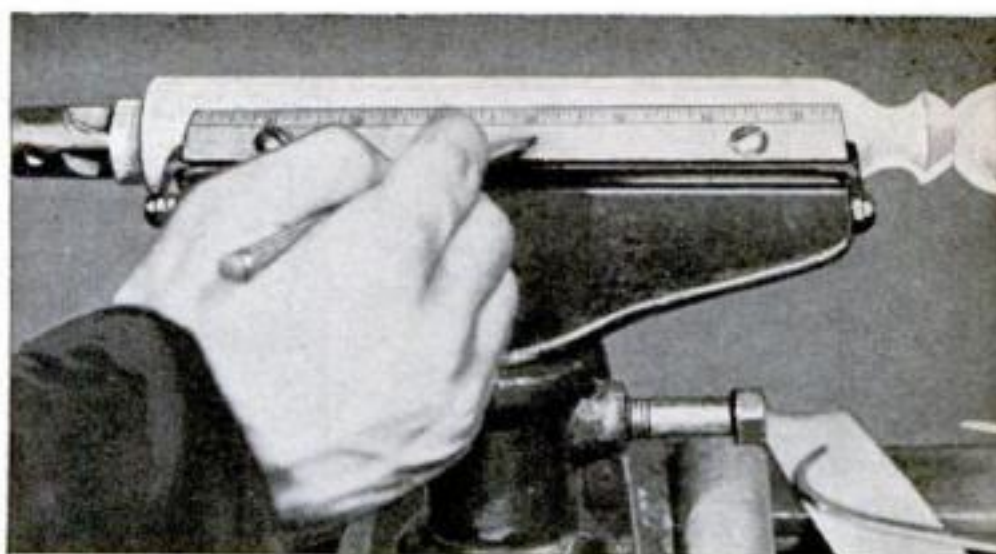
On certain jobs, such as making hexagon-head cap screws, an adjustable stop should be the first tool set up. A convenient form of stop is shown among the various holders in Fig. 9. This is merely one of the tool holders with an adjustable rod sliding in a collar and held in place with a set screw.

Drills, taps, and other straight-shank tools (Fig. 10) can be firmly held in the tool holders with the same safety set screw that fastens the holders in place, a small hole being drilled in the side of the holder to allow the set screw to pass through and bear directly on the tool shank, clamping both the tool and the holder securely in place.



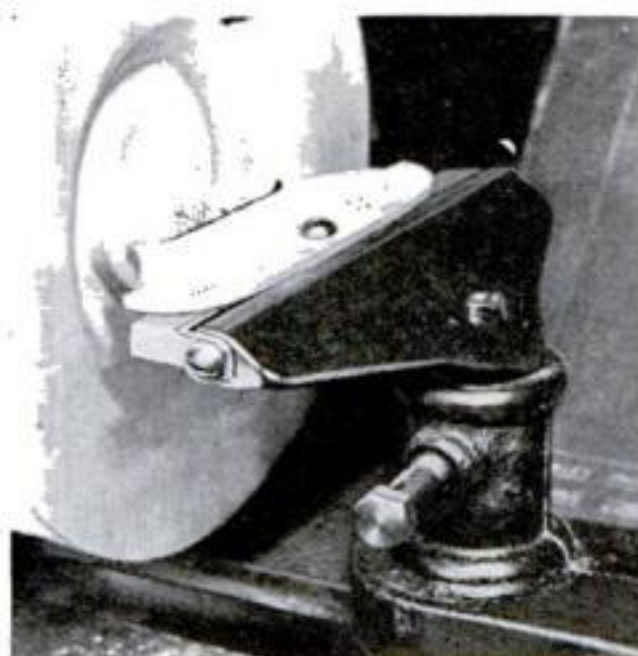
Lathe Tool-Rest Fixture Holds Scale or Template

A FIXTURE to hold a scale or template while turning wood to shape may easily be made from a piece of sheet iron and fastened to the tool rest as shown. Each end of the tool rest will have to be cut off a suitable distance back to provide enough metal for a small threaded hole; or if the shape of the rest does not warrant this, a small bracket might be made from band iron and either welded or bolted to the underside of the rest. When not in use, the fixture may be turned down beneath the tool rest.—E. C. H.



Circles Scribed on Bench Aid in Making Layouts

ON MY metal-top bench, I have made a center-punch mark with circles and cross lines, which are useful for scribing a circle on a disk that has a hole at the center or for locating the center of small disks.—W.P.S.



The fixture is fastened to the ends of the rest



Blade in Vise Cuts Awkward Work

WHEN the frame of a hack saw cannot follow the blade in cutting heavy tanks and sheet iron, try holding the blade in a small vise, as at left, after the cut has been started with an ordinary hack saw. The blade, or piece of a broken one, is clamped in the vise with the teeth set to cut on the pull stroke instead of the push stroke.—R. B.



A Shop Tray That Won't Upset

A DISCARDED ash receiver of the weighted-base type forms an ideal stand for a portable shop utility tray. Fasten a small wood tray, partitioned as desired, to the top of the stand with small bolts, and add a handle. Pour additional lead weight into the base if required. The tray may be made of plywood or any available wood scraps.—JAMES J. WENNER.



Part of the rack fits between the lathe legs, which hold it in place



Shop Floor Racks Made from Ordinary Laths

FOR workshops that have concrete floors, a platform can be made from ordinary wood laths 4' in length. The one illustrated was planned to fit between the legs of a lathe, which hold the rack in place. The crosspieces are about 8" apart, and the lengthwise pieces $\frac{1}{2}$ " apart. If it is desired to make a longer rack, the upper laths should be nailed so that no two joints adjoin each other on the crosspieces.

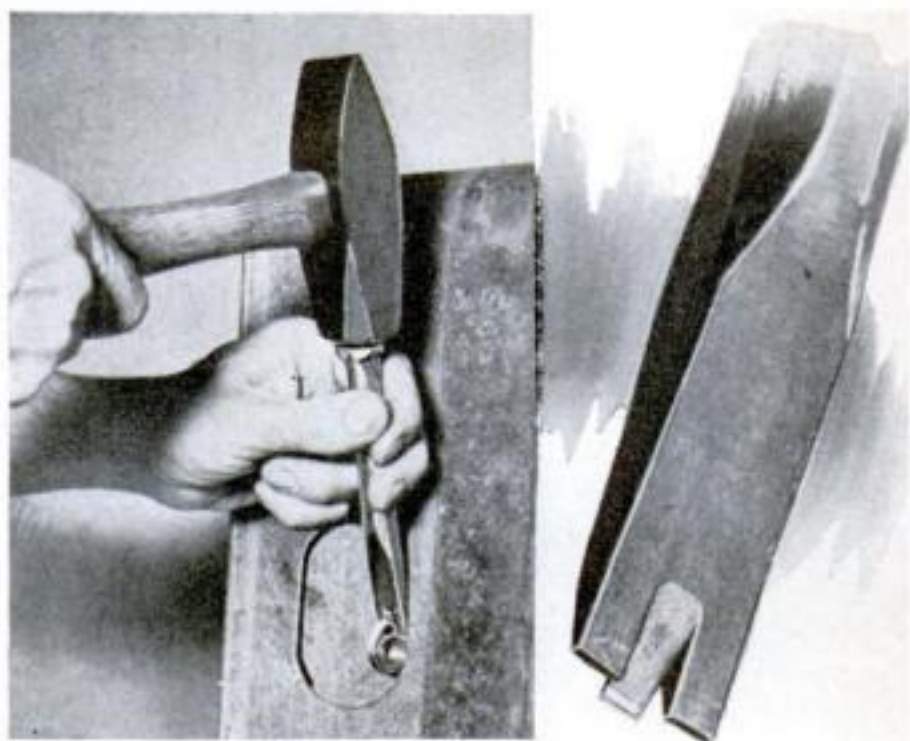
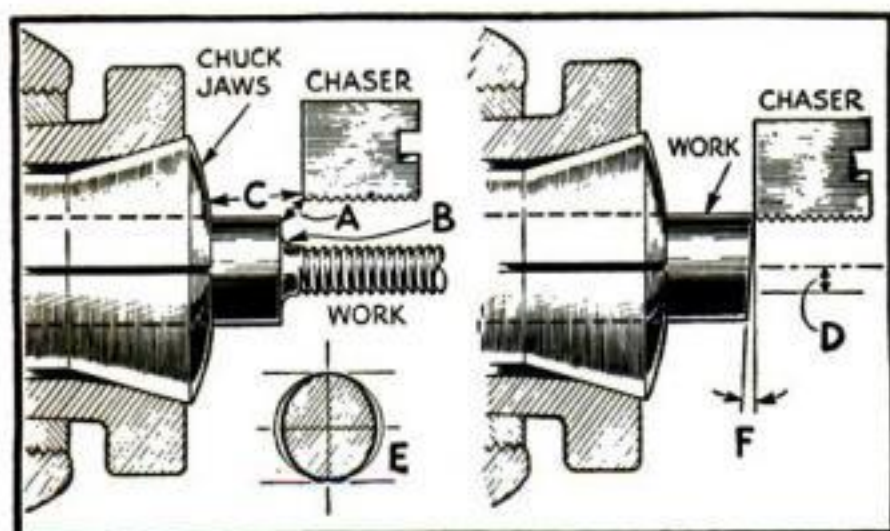
Mixture Aids Babbitting

WHEN rebabbitting bearings, one usually finds the clay in the workshop has dried out and it takes longer to get it into condition than to do the babbitting job. Old asbestos pipe covering, if broken up and mixed with any available oil to the consistency of putty, does not dry out, is always ready to use again, and reduces the risk that the metal will splatter because of the presence of moisture.—C. C. P.

How to Reduce Breakage of Threading Chasers

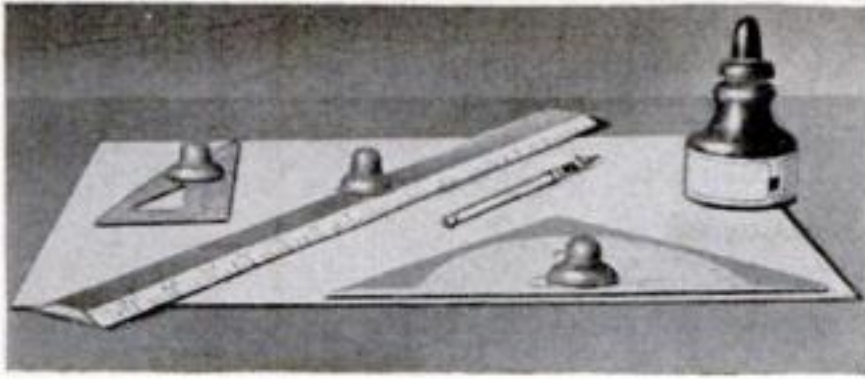
MUCH unnecessary depreciation of threading chasers is due to the following mishaps: Running into an actual shoulder on the work (A). Running into a fillet in front of the shoulder (B). Running into the chuck jaws (C). Misalignment between work and threading heads (D). Stock that is out of round or oversize (E). Stock not cut square (F).

Always cut a recess in front of the shoulders if possible. When this cannot be done, so-called "projection chasers" should be used. The chamfers should come out on the top face of the chasers no less than 0.020" below the root of the chaser teeth. All chamfers of a set of chasers must be alike.



Specially Ground Chisel Cuts Odd-Shaped Holes

IRREGULARLY shaped holes in sheet metal too heavy to cut with tin snips may be made neatly with an ordinary cold chisel specially ground to the shape shown above. This particular chisel was ground on a $\frac{3}{16}$ " cutting wheel. A hole is, of course, drilled in the sheet metal in which to insert the small point of the chisel for starting the cut. File the edge of the opening afterwards.—N. B.



Drafting-Tool Handles

IN DRAFTING, blots are sometimes made when a triangle slips over a freshly inked line. Both triangles and protractors can be lifted from the drawing without fear of blotting if small rubber suction cups are pressed on, as illustrated above. Flat drafting scales can also be handled with facility by this means.—R. B. ROCHESTER.

Bar of Solder Hangs on Nail

IF YOU take pride in keeping your workbench neat and clear of tools and materials that are not in use, solder a loop of wire to one end of your bar of solder so that it may be hung out of the way on a nail. Minutes may often be saved on rush jobs by having the solder where it can be found without any delay.



The wires of a grill can be held while being soldered by sticking them down on pieces of friction tape



Tape Keeps Wires Spaced While Being Soldered

TO KEEP a number of wires equally spaced while constructing a grill, one tinsmith tacked a couple of strips of friction tape to the bench top, gummy side up, and arranged the wires upon them.

THE sharp corners and edges of rough boards that are being used in making packing boxes and for other common construction can be quickly beveled by tapping them with a hammer. Use the flat side of the hammer on long edges.—J. M.

MELTING POINTS OF METALS

[METAL WORKING]

Name of metal	Chemical symbol or composition	Melting point in degrees Fahrenheit
Aluminum	Al	1216-1220
Aluminum bronze	(90 Cu, 10 Al)	1922
Brass, ordinary yellow	(67 Cu, 33 Zn)	1724
Bronze (for brazing)	(55 Cu, 45 Zn)	1616
Bronze, gun metal	(90 Cu, 10 Sn)	1850
Bronze, other types		1616-1940 (approx.)
Carbon (graphite) nonmetallic, but used for crucibles	C	6330
Chromium	Cr	2741-2768-2939
Copper	Cu	1981.4
Gold	Au	1945.4-1950
Gold, coin	(90 Au, 10 Cu)	1724
Iron, pure	Fe	2740-2795
Iron, cast, white	(97 Fe, 3 C)	2102-2400
Iron, cast, gray	(94 Fe, 2.5 Si, 3.5 C)	2200-2246
Iron, wrought		2740
Steel, mild	(0.10% C)	2740
Steel, medium carbon tool	(1% C)	2606-2630
Steel, other types		2417-2750 (approx.)
Lead	Pb	620.6
Solder	(1/3 Sn, 2/3 Pb)	465
Magnesium	Mg	1204
Mercury	Hg	-38
Nickel	Ni	2645.6
Platinum	Pt	3191
Silver	Ag	1762
Solder—See "Lead"		
Steel—See "Iron"		
Tin	Sn	450
Tungsten	W	6062-6116-6404
Zinc	Zn	787

Note: In the composition of iron, Si represents silicon. Standard reference tables do not agree on all metals. For instance, in three authoritative references, the melting point of tungsten is given at 6062, 6116, and 6404. From a practical standpoint, the values listed above are close enough.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Kitchen Chemicals

OFFER THRILLS
for
EXPERIMENTERS

Heating washing soda to expel the moisture held by the sodium carbonate. The vapor condenses in the test tube at right

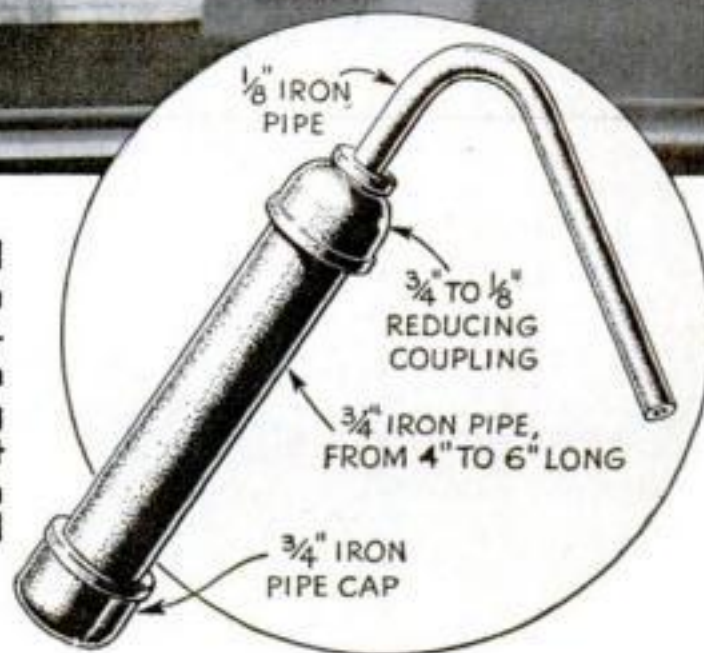


DOES your home laboratory face a temporary shutdown, because previous experiments have depleted the contents of your chemical bottles? If so, a visit to your kitchen, laundry room, and medicine chest will be worth while. You may find new materials in the form of such familiar and inexpensive household products as lye, washing soda, baking soda, and sugar.

The lye that grocery stores sell for a few cents a canful is essentially sodium hydroxide. While it contains about six percent of chemical impurities, these will not impair its usefulness for many home-laboratory purposes. Because it absorbs moisture from the air, and is gradually converted to sodium carbonate by atmospheric carbon dioxide, it must be kept tightly stoppered. You will find that it lends itself to an entertaining variety of experiments.

If anyone asked you how to make hydrogen gas, probably you would think first of

Metal pipe and fittings form a retort for making hydrogen gas by heating iron and lye. It can be taken apart to reload



using a metal and an acid. But did you know that lye, a powerful alkali, could be used in place of the acid? To try it, mix some lye with iron nails, tacks, or filings, in about equal proportions, and place the mixture in an upright test tube. Heat the tube gently at first, from all sides, with a Bunsen burner or a good alcohol lamp held in your hand. This will expel moisture from the lye.

At intervals, test the escaping vapors for hydrogen with a lighted match. If the match flame is extinguished, steam is still being driven off and the reaction has not yet be-

By **RAYMOND B. WAILES**

gun. So continue heating, more vigorously.

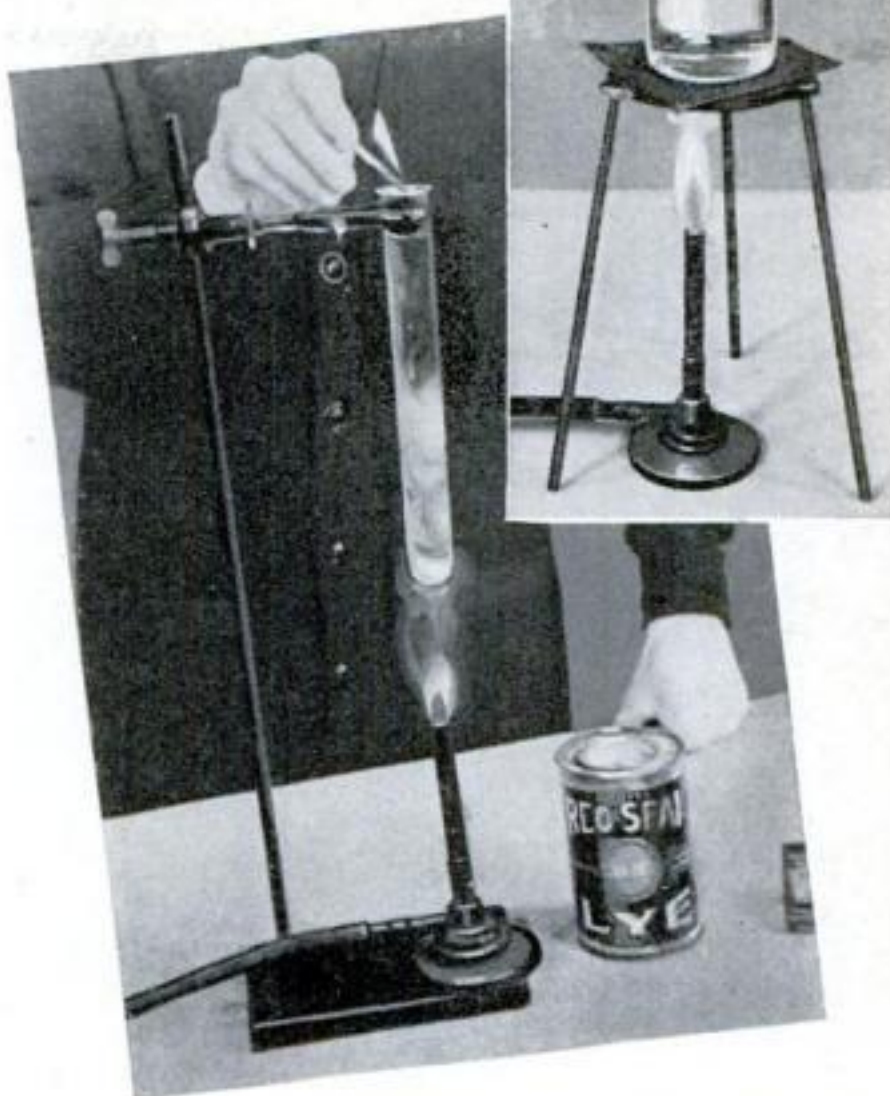
After a time the issuing vapor can be ignited momentarily, and will finally burn continuously. If you are using a small test tube, the flame will be at the mouth. In a larger test tube, of about 1" diameter, the flame will "strike back" and burn at the surface of the iron-lye mixture. It will be yellow, owing to the sodium compound, and not colorless, as the flame of sodium-free hydrogen would be. However, this extremely slight trace of impurity will make no difference if you use the hydrogen in tests.

The test tube employed in this experiment must be discarded afterward, as the hot lye will certainly attack the glass. But if you are attracted by this very inexpensive method of making hydrogen gas, you can use an all-iron heating vessel for the gas generator. To a piece of iron pipe 4" to 6" long, with an inside diameter of $\frac{3}{4}$ ", attach a pipe cap of corresponding size. Fill the pipe with the lye-iron mixture. Then fit the other end of the pipe with a reducing coupling, and complete the assembly by inserting a length of $\frac{1}{8}$ " pipe, suitably bent, to serve as a delivery tube. When the chemicals are used up, the homemade retort is simply taken apart and refilled.

Here is another way to make hydrogen with lye. Dissolve the lye in water, and let the solution act upon scraps of aluminum in a flask. To start generating the hydrogen, apply gentle heat to the flask. The flame may then be removed, and the reaction will proceed briskly without further assistance. Zinc metal may be substituted for the aluminum in this experiment.

A recent article of this series (P.S.M., May '40, p. 192) pointed out the handy trick of preparing any desired chemical compound by dissolving the carbonate in the corresponding acid. The hydroxide may likewise be used, and in many cases lye may be employed as a go-between to prepare it.

Set on a beaker of boiling water, a custard cup of heat-resisting glass makes a handy evaporator



Making hydrogen without acid. The gas burns at mouth of test tube

Suppose you have some copper sulphate, and want to make copper nitrate. Make a solution of the copper sulphate and add a solution of lye. This will form a precipitate of copper hydroxide. Wash it well by decantation, and then filter it off. Now dissolve the copper hydroxide from the filter paper in dilute nitric acid, using as little acid as possible. The result is a solution of copper nitrate.

If you desire copper acetate, instead, prepare the copper hydroxide as above and then dissolve it in acetic acid. The same procedure may be used for many compounds other than those of copper.

In certain cases, care must be taken not to use too much lye, or the precipitated hydroxide will redissolve. This applies to compounds of aluminum, zinc, chromium, lead, antimony, and tin. In preparing these hydroxides, add a small amount of lye solu-



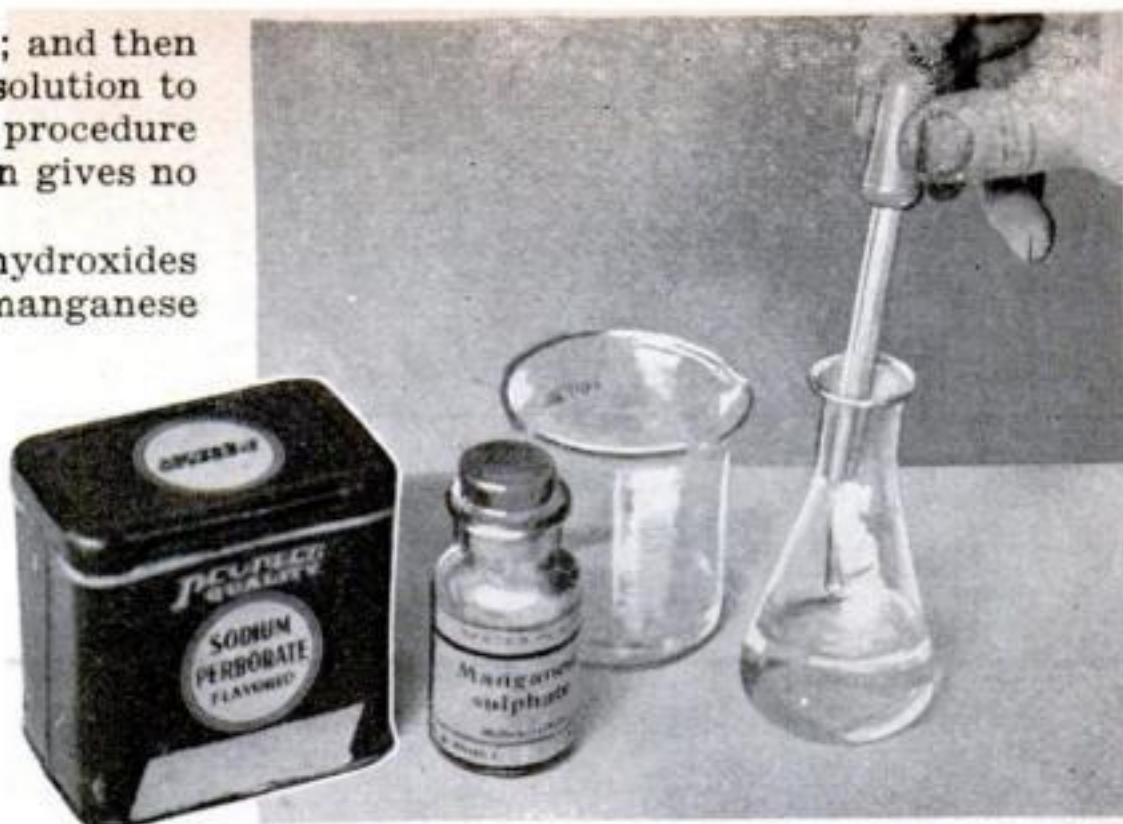
Lye added to a solution of sugar in alcohol causes a white precipitate to form

tion; stir; let the precipitate settle; and then add a few more drops of the lye solution to the clear upper liquid. Repeat this procedure until a new addition of lye solution gives no precipitate.

You need not precipitate the hydroxides of copper, iron, cadmium, and manganese so gingerly, since they will not redissolve in an excess of lye solution. On the other hand, some hydroxides cannot be precipitated at all with lye solution. These include the hydroxides of calcium, barium, strontium, ammonium, and potassium.

Washing soda may be within handy reach, in your home; or, for as little as ten cents, you can buy quite a large box of it. Its chemical name is sodium carbonate. A fresh package will contain large crystals, in which each molecule of sodium carbonate has ten molecules of water attached to it. On exposure to the air, the crystals slowly crumble into white powder, losing three of the ten water molecules in the process. This phenomenon goes by the name of efflorescence. Though the powder seems perfectly dry to the touch, it still contains seven water molecules to each one of sodium carbonate.

You can easily show that sodium carbo-



How "oxygen bath salts" work. Manganese sulphate decomposes sodium perborate, releasing oxygen

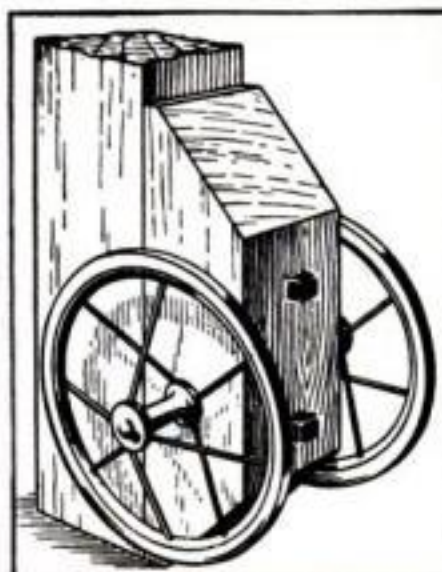
nate holds such a high percentage of water by heating it, and condensing the expelled moisture. Completely fill a test tube with washing soda—either the fresh crystals or the powder. Fit the tube with a one-hole cork, carrying an L-shaped length of glass tubing. With a short piece of rubber tubing, connect the end to a second L-shaped section of glass tubing, with one limb 8" to 10" long. Let this limb reach the bottom of an empty test tube, (*Continued on page 227*)

Workbench on Wheels Is Easily Moved

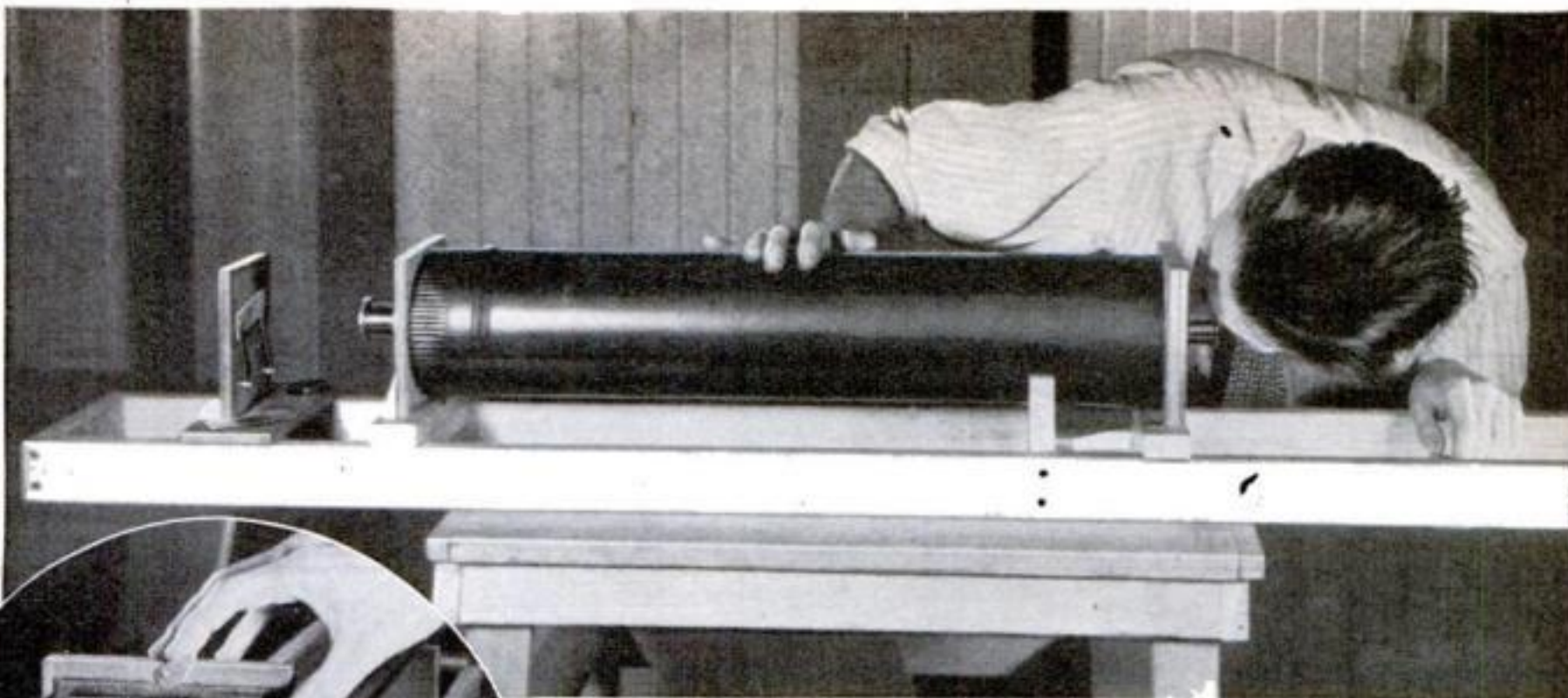


Machine bench fitted with wheels. Weight is normally on legs, as seen in the inset

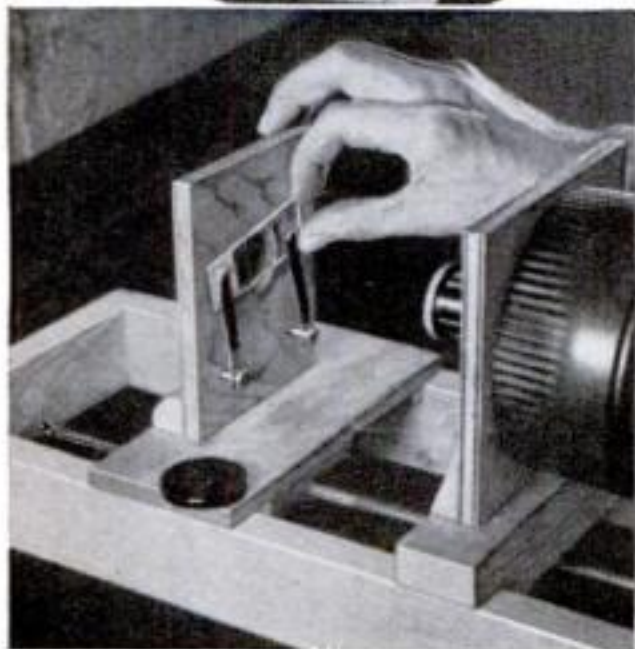
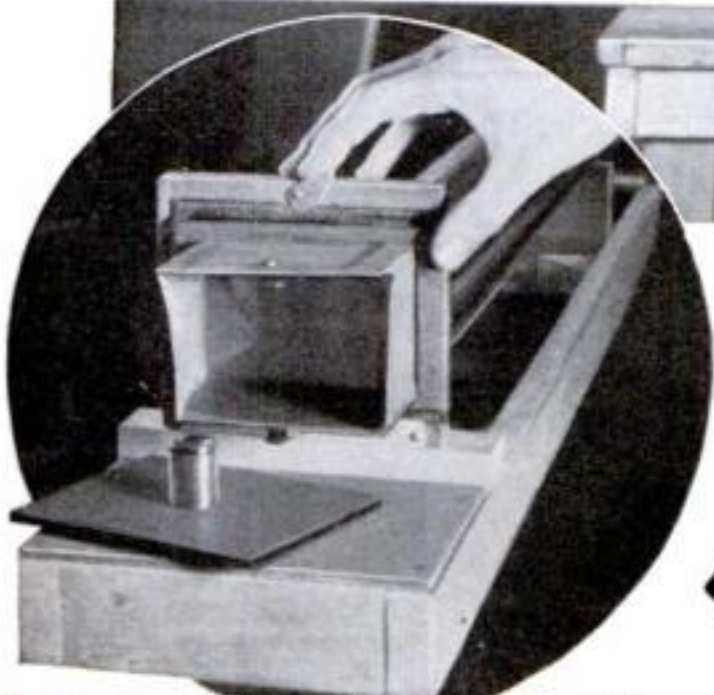
SMALL wheels mounted on two legs of a workbench or machine bench as shown in the accompanying drawings enable it to be moved out into the center of the shop or to any other convenient position for use. This is especially helpful when a garage is used as a shop and the bench or benches have to be pushed against the wall to make room for the car, or when only a small cellar space is available. When the bench is in the normal position, the weight rests on the four legs. To move



it, one end or side is raised a few inches to shift the weight to the wheels, when it can be rolled to the position desired. For added convenience, a pair of handles may be attached to the end or side of the bench.—O. C. SPRINKLE.



Stovepipe microscope in use. There is a magnifying eyepiece at the right-hand end, a photographic objective at the left



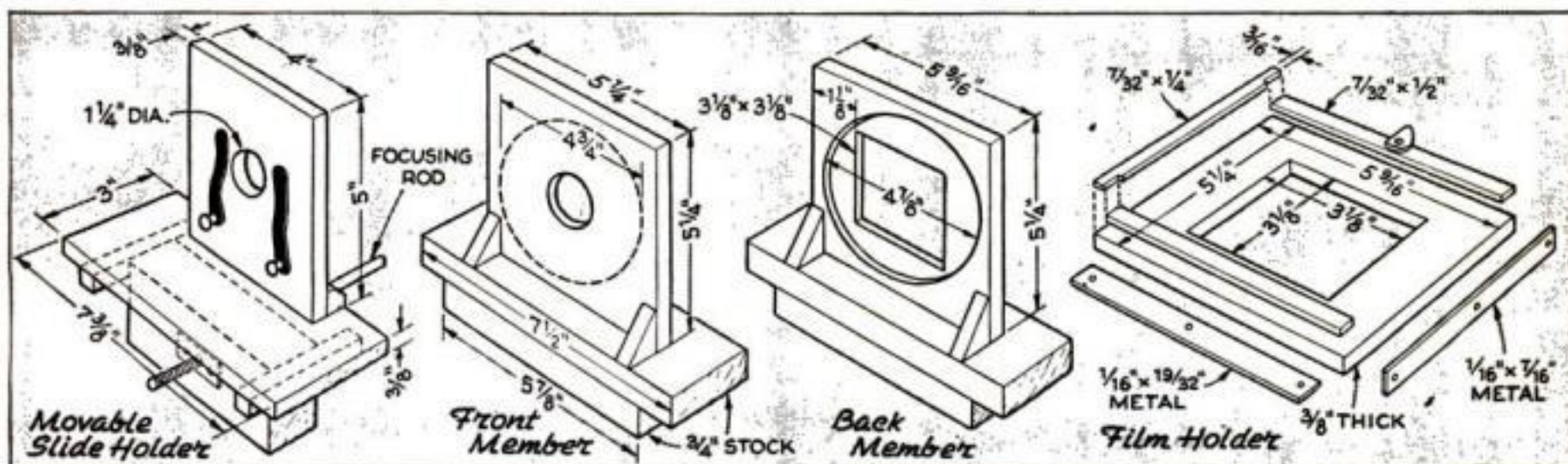
Clips support specimen slides on the object holder, which moves along the frame. In the circle, above, are the viewing screen and a lens used as an eyepiece

FUN WITH A *Stovepipe* Microscope

BY USING a stovepipe for a tube, you can easily assemble a combination visual microscope and photo-micrographic camera that will provide hours of instructive entertainment. Insects of all kinds may be viewed through it, and when it is equipped with a good photographic lens, unusual pictures at moderate magnifications can be made. In fact, it will perform almost as well as similar and very costly equipment used in industrial laboratories for photographing everything from fish scales and insects to silk cloth and small machine parts.

With a camera lens of 2" focus as the objective, and a tube length of about 46", the outfit illustrated gives a magnification of somewhat more than 20 diameters on a ground-glass viewing screen or [\(Continued on page 228\)](#)

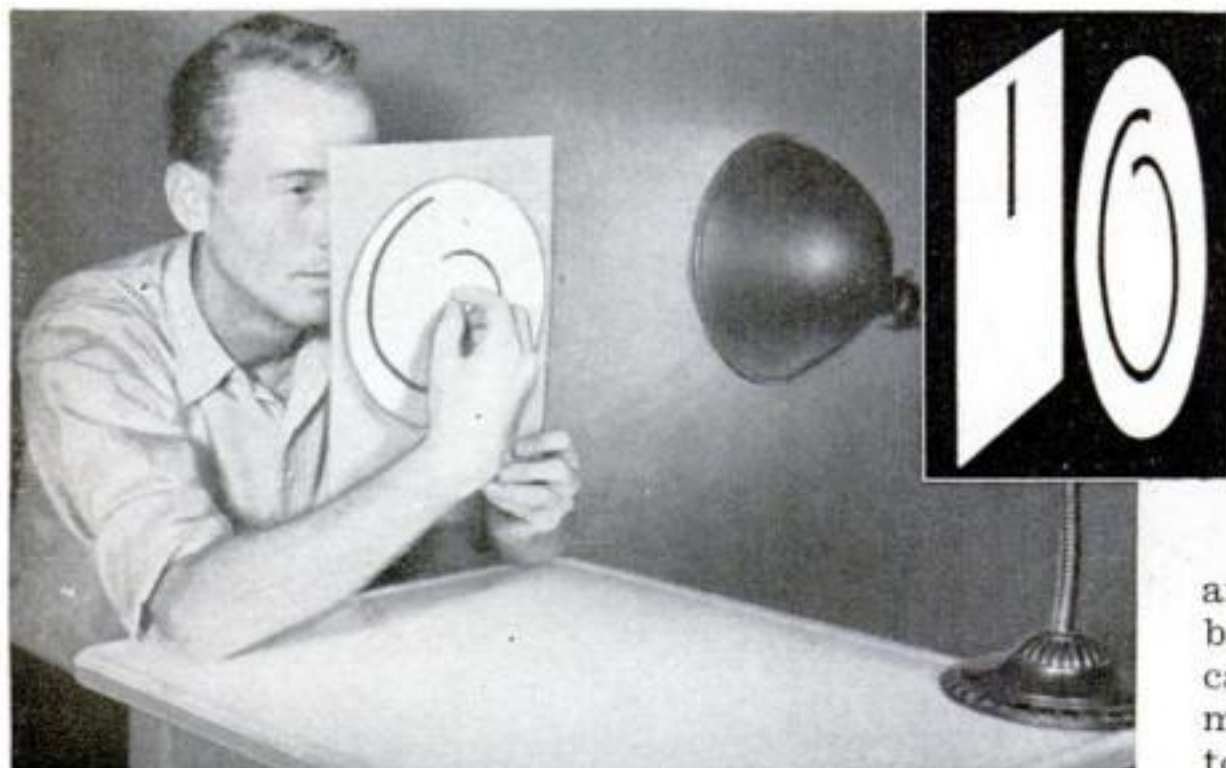
By MORTON C. WALLING



Construction details of object holder, front and rear members, and frame for viewing screen and eyepiece

TESTS FOR THE HOME

Stunt Shows Common Optical Illusion



CUT a vertical slot in one piece of cardboard, and a spiral slot in another. Now twirl the second behind the first, in a clockwise direction, while looking at a light. Repeatedly, a spot of light will travel up the vertical slot. After watching this for a quarter minute, suddenly stop the disk. The spot of light, though actually stationary, will seem to be running backward. Likewise, when a car or train stops, the scenery may appear for a few seconds to be moving, so that you seem to be going backward.

When the disk stops, the spot of light seems to move backward

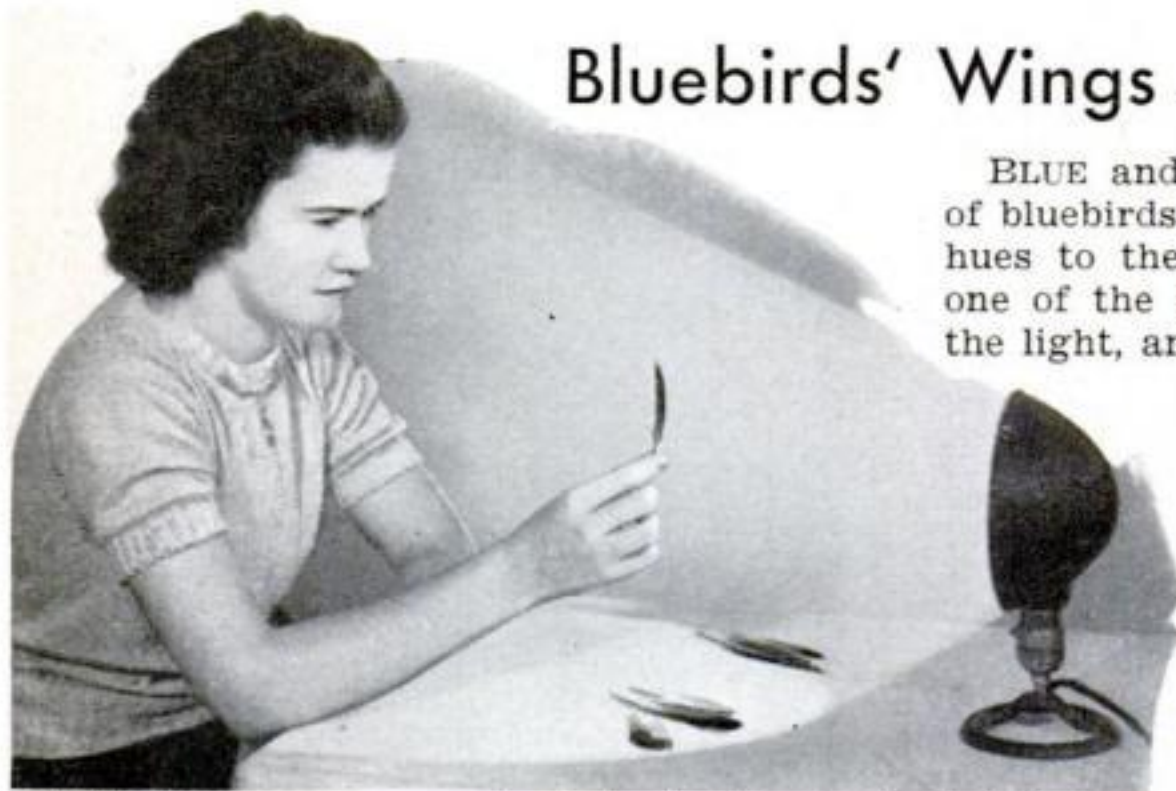
Electric Fans Illustrate Fluid Drive for Cars

TWO electric fans will demonstrate the action of "fluid drives" recently introduced on busses and private cars. Connect only one fan to the current supply, and let its air blast turn the other fan. Even if the first fan, representing the car's engine, is started suddenly, the second or driven fan will smoothly pick up speed, at a rate depending on its inertia. Stop the driven fan abruptly, and the first fan is scarcely affected. In motor cars, oil replaces air as the connecting medium.



Air forms the connecting medium between the fans

Bluebirds' Wings Are Really Brown



Held between your eyes and a light, the blue feather looks brown

BLUE and green feathers, such as those of bluebirds and peacocks, do not owe their hues to the color of their pigment. Hold one of the feathers between your eye and the light, and you will see that its pigment really is brown! When viewed by reflected light, the feathers assume different hues because of thousands of microscopic prisms on the barbs, which refract blue or green light and absorb the rest. Ordinary feathers show their true colors whether they are examined by transmitted or by reflected light.

SCIENTIST

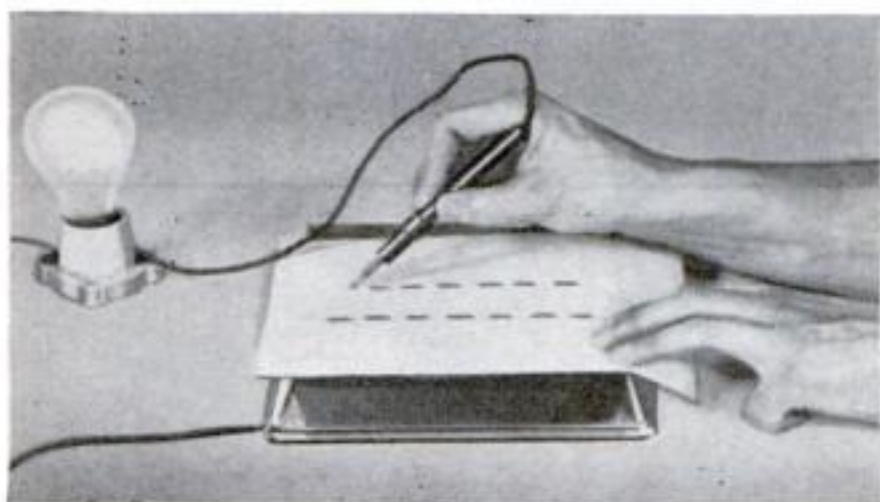
Test Shows Where Electric Charge Gets Energy

SUSPEND a smooth-edged can cover by silk threads from a light spring. Lower the cover on an electrophorus plate that has been charged by rubbing (P. S. M., Nov. '39, p. 211). Lift the cover without touching it first with your finger to charge it, and the spring is scarcely stretched. Repeat, touching the can cover to charge it, and the spring stretches considerably. The experiment shows that the work done in withdrawing the cover is what imparts its electric energy, rather than the work of rubbing the electrophorus plate.



Stretching of the spring, as at right, shows that more work is required to lift the lid after it has been charged

Seeing Alternating Current Alternate

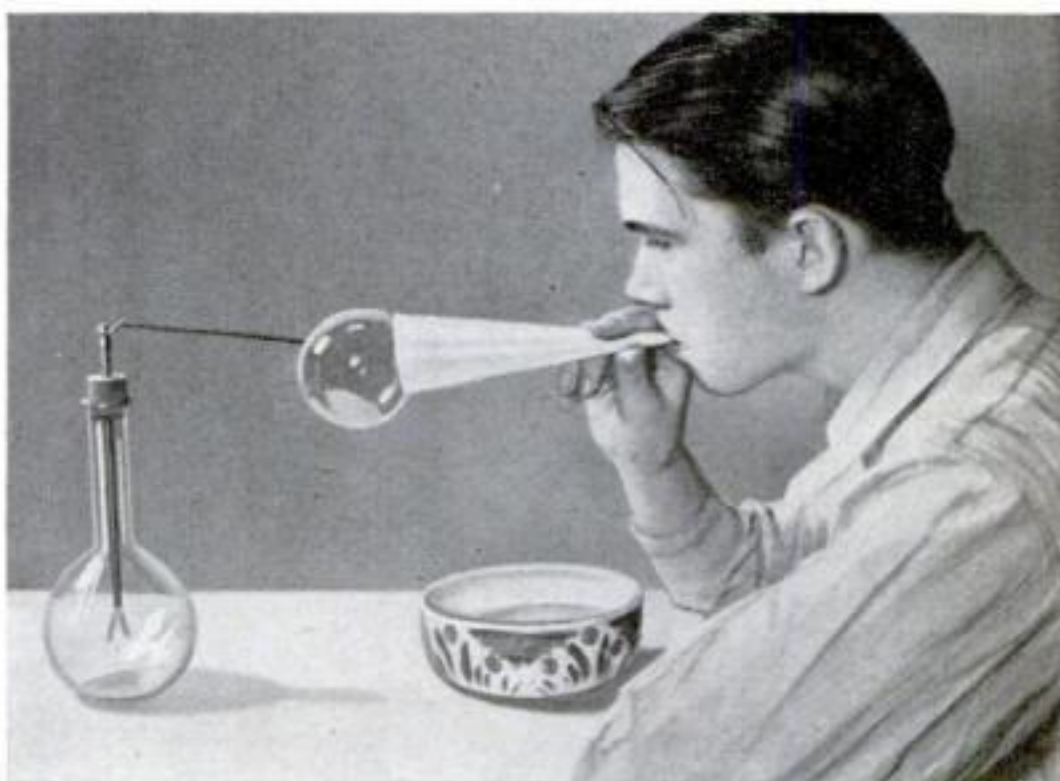


"Electric pencil" makes a dotted line on the paper

TO MAKE the pulsating nature of alternating current visible, soak a sheet of paper in a solution of starch and potassium iodide. Lay the moist sheet on a metal plate connected to one wire of a 110-volt alternating-current supply. Insert a lamp on the other side of the line, as shown, and fit the bared tip of the wire with an insulating grip. Using it as a pencil, draw it across the treated paper at varying speeds. A dotted line results, the chemicals recording each reversal of the current.

Bubble Illustrates Use of Condenser

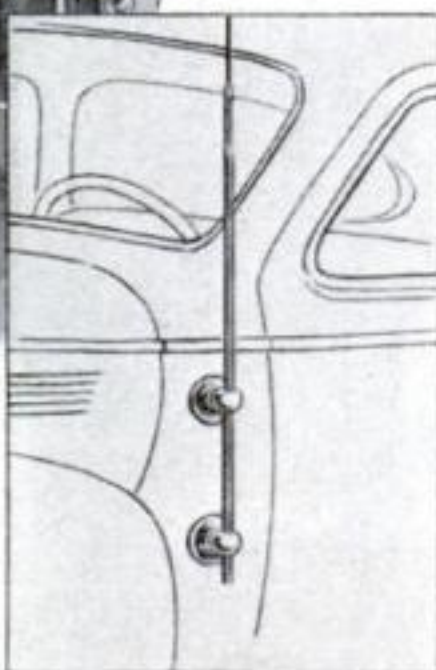
FASTEN a wire to the ball of an electroscope and bring a small soap bubble into contact with the wire. Charge the electroscope with an electrophorus. Blow the bubble larger, and the leaves will fall together, showing that the potential is diminishing. Letting the bubble shrink has the opposite effect. Potential varies with the area of a surface, a charge being spread out more thinly as the surface increases. The principle is used in electric condensers.



As the bubble expands, the potential of the charge diminishes



Fitting antenna mountings from one of the kits to the curved panel of a car



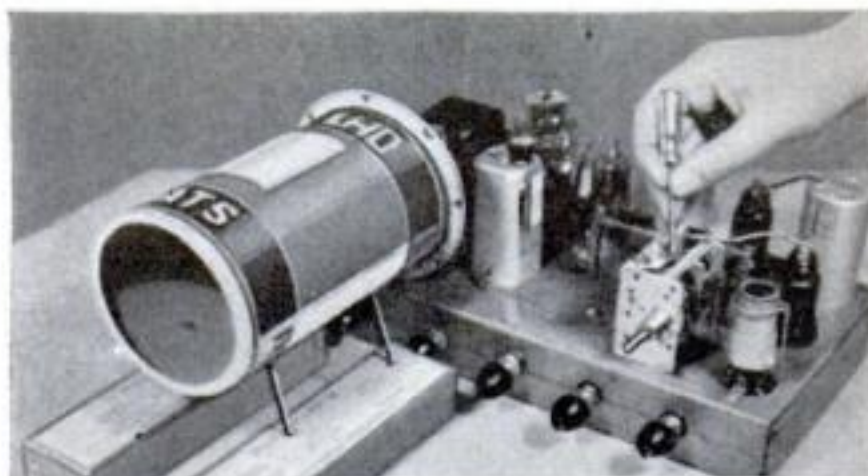
Novelties

Antenna-Mounting Kits Contain All Parts To Fit Any Make of Car

BECAUSE the contours of the side cowls of various 1940 automobiles vary widely, making it difficult to mount car antennas in a vertical position, one manufacturer is offering inexpensive kits containing the necessary hardware to mount antennas properly on a number of different makes of cars. A flat washer, lock washer, chrome-plated brass cap, a ceramic insulator, and a template for drilling the necessary holes in the car body are contained in each kit.

Speaker Tester Is Made from Oatmeal Container

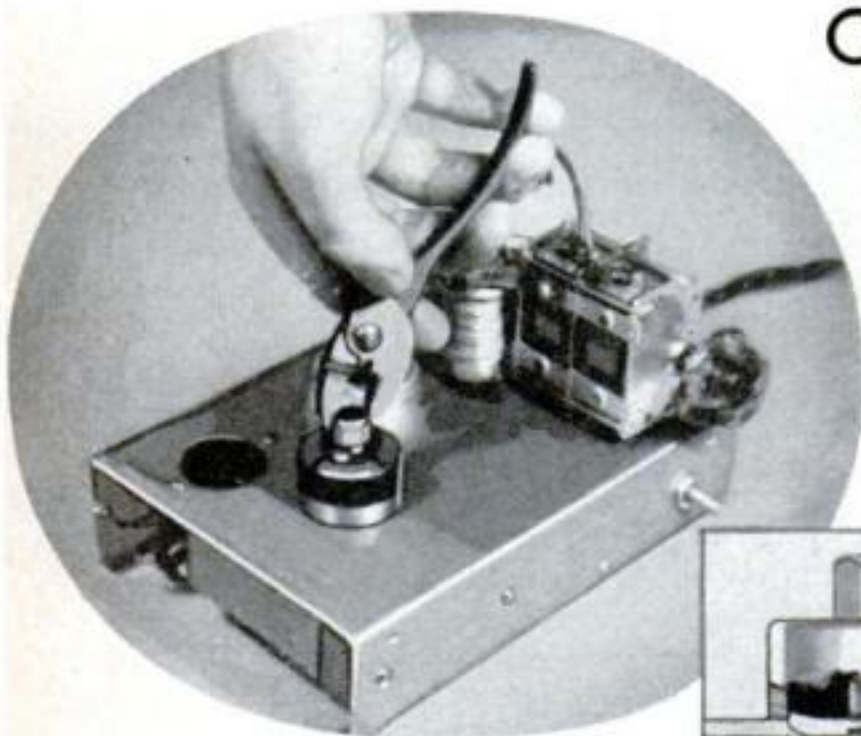
AN EMPTY, twenty-ounce oatmeal container with most of the ends cut out makes an effective baffle for four or five-inch speakers to test their tone and volume before the set is installed in its cabinet. Four two-inch brass screws provide feet for the device. In use, it is placed with one open end close to but not touching the speaker.



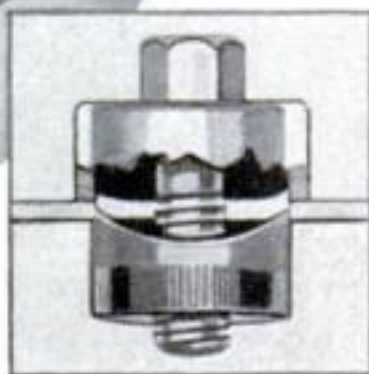
How oatmeal container is used as a speaker tester

Chassis Socket-Hole Puncher Works Like a Cookie Cutter

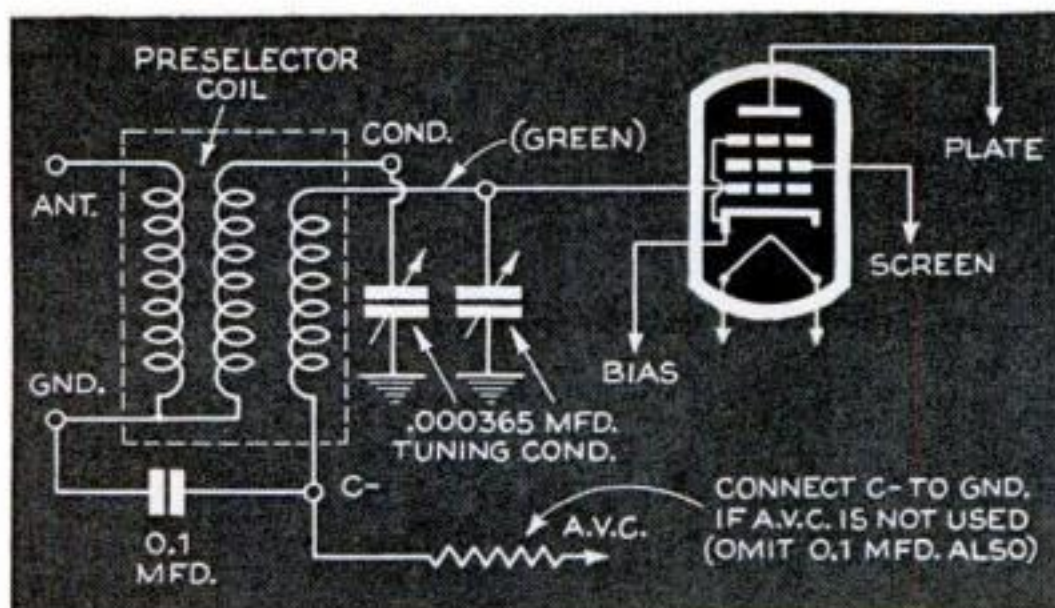
A HANDY tool that works like a cookie cutter for making holes in a radio chassis to take tube sockets and other parts has just been introduced. The tool requires no hammering, thereby eliminating the danger of throwing already-installed condensers or intermediate-frequency transformers out of line. The cutting is done by inserting a threaded bolt up to its cup-shaped head through a drilled hole, then attaching the uniquely designed cutter to the bolt on the other side of the chassis. Turning the head of the bolt draws the cutter against the metal to make the hole. It comes in seven sizes, from three quarters to 1 3/8 inches.



Turning the bolt head with pliers cuts a clean hole. Inset shows cut-away view of the handy device in use



in the World of Radio

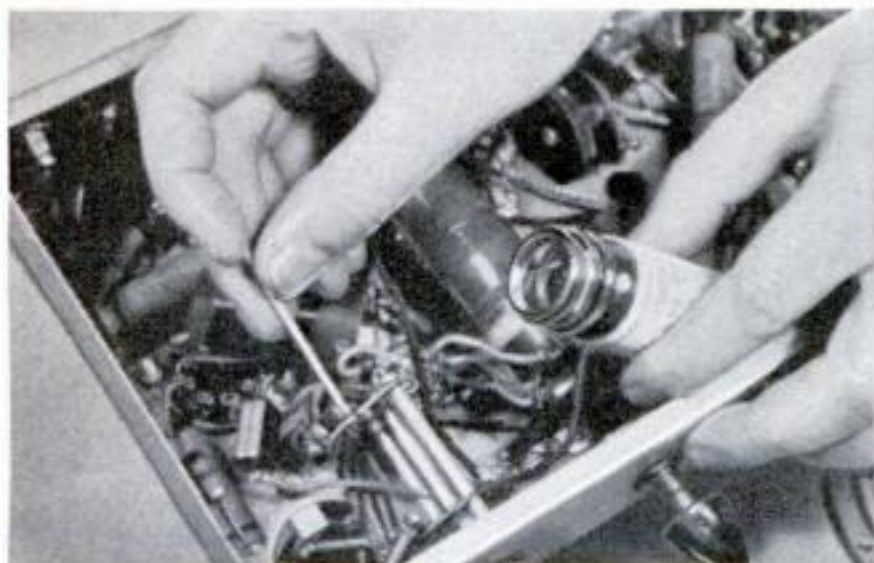


The preselector coil eliminates overlapping signals. Drawing at left shows how it is wired to any radio

Preselector Coil Improves Radio Tuning

FULLY shielded, and designed compactly so that it will fit in most radio cabinets, the preselector coil illustrated above will improve your present broadcast set by eliminating any overlapping of signals. Installed with a .000365-mfd. tuning condenser, it will

operate efficiently with any receiver circuit, whether superheterodyne or tuned radio frequency. The coil will tune between 190 and 550 meters with the condenser recommended. The shield can is one and three quarter inches square by three inches high.



Applying the switch oil to contacts with a match

Lubricant for Switches Keeps Contacts Clean

PREVENTING oxidation of the silver and silver-plated contacts on wave-band switches and on tone, volume, push-button, and other controls, a new liquid now being sold assures noise-free operation of the circuits of radio receivers. The preparation is composed of several chemicals dissolved in a light mineral-oil base. The oil provides a gumless lubricant, while the chemicals have a cleaning effect on contacts.

Mike-Size Broadcaster Has Many Uses

YOUR own imagination is the only limit to the variety of uses for the novel device illustrated at the right. Actually a tiny transmitting set, it is not much bigger than a microphone. It broadcasts on a wave length to which any broadcast-band receiver may be tuned, thus making it possible to speak or sing through the receiver's amplifying system. Housed in a composition case, the unit transmits to near-by receivers without any electrical connections as soon as it is plugged into a house-current outlet. Among uses to which it may be put are as a "radio nurse" in the sick room or nursery; for rehearsals and auditions for amateur plays, for comments and sound effects for home movies, and for speech-improvement exercises.

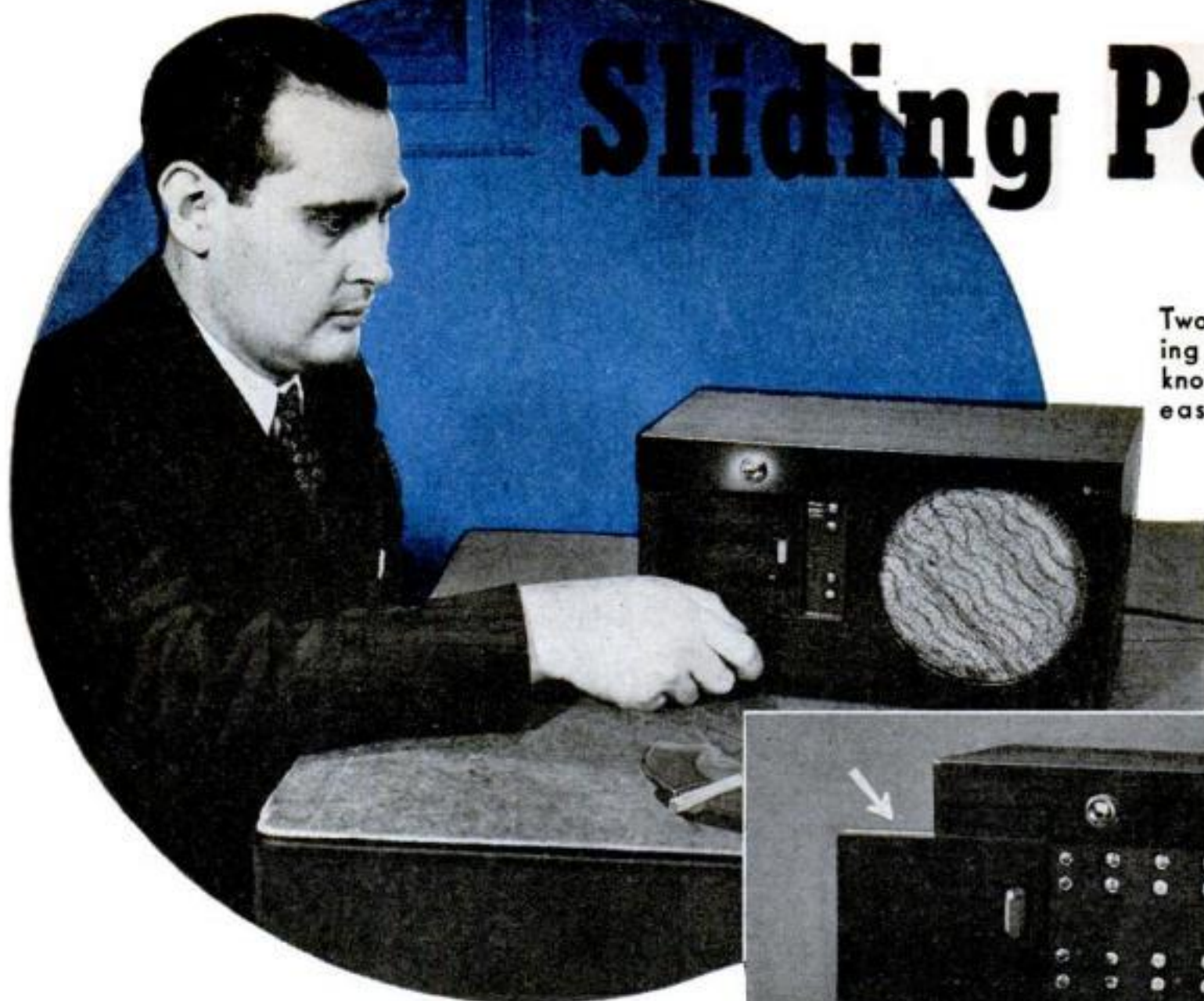


This unit lets you talk through your radio without wires from any room in the house

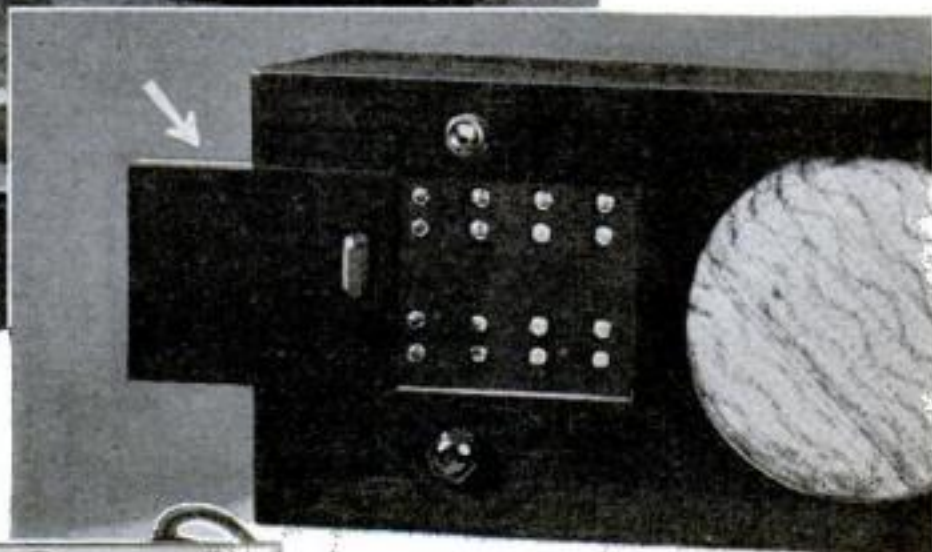
Sliding Panel

Two controls — a sliding panel and a volume knob — operate this easily built receiver

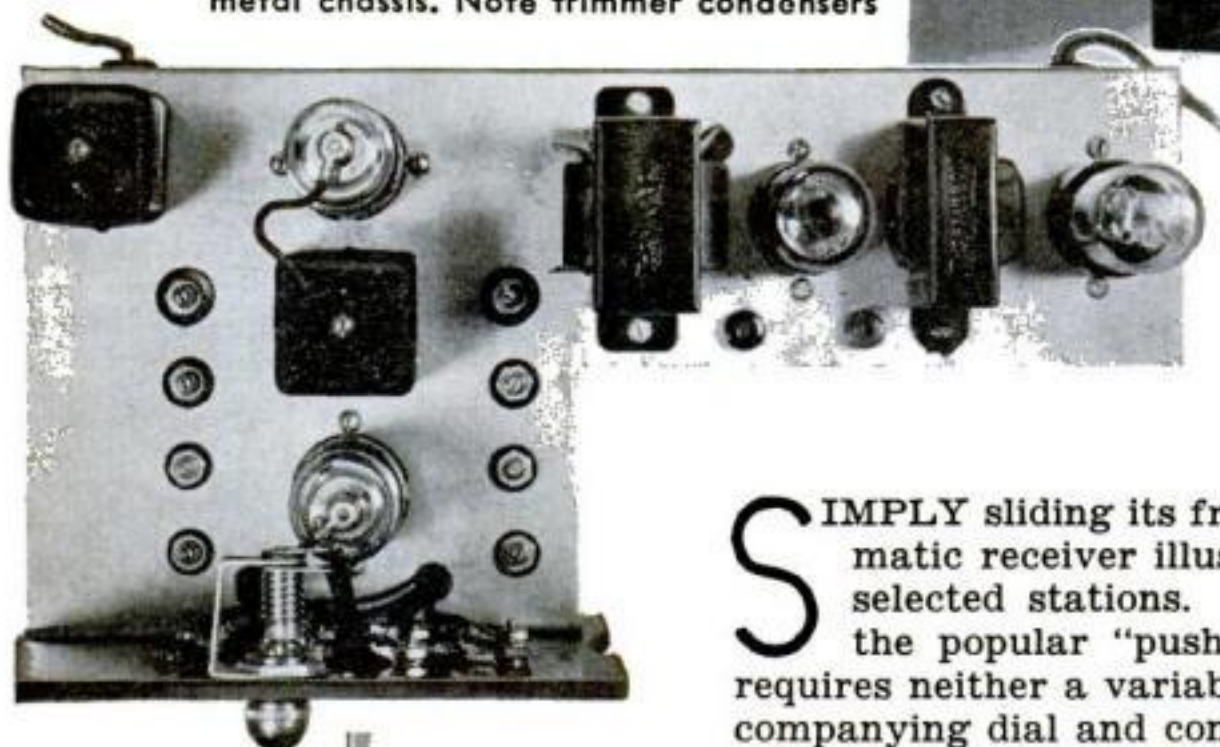
By
**FRANK
TOBIN**



Top and bottom views of the L-shaped metal chassis. Note trimmer condensers



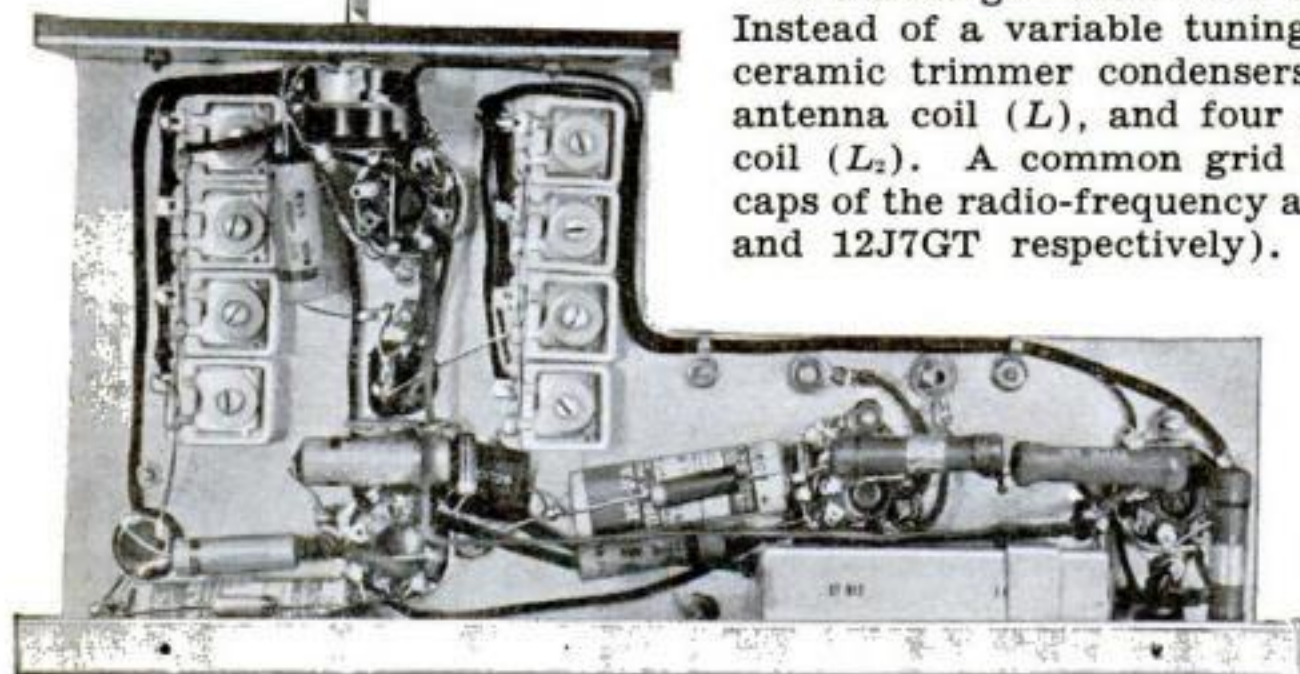
Metal strips backing the panel contact the screw heads to connect the condensers into the circuit



SIMPLY sliding its front panel tunes the novel automatic receiver illustrated to any one of four pre-selected stations. Operating on the principle of the popular "push-button" receivers, the circuit requires neither a variable tuning condenser nor its accompanying dial and control.

The arrangement of the circuit is unusually simple: Instead of a variable tuning condenser, a set of eight ceramic trimmer condensers is used—four across the antenna coil (L_1), and four across the radio-frequency coil (L_2). A common grid lead connects them to the caps of the radio-frequency and detector tubes (12K7GT and 12J7GT respectively). Their ground leads, not grounded directly to the metal chassis, are wired to sets of metal screws mounted on the composition panel, as shown. These screws serve as contacts, and as two phosphor-bronze strips mounted on the rear of the sliding

panel, are wired to sets of metal screws mounted on the composition panel, as shown. These screws serve as contacts, and as two phosphor-bronze strips mounted on the rear of the sliding



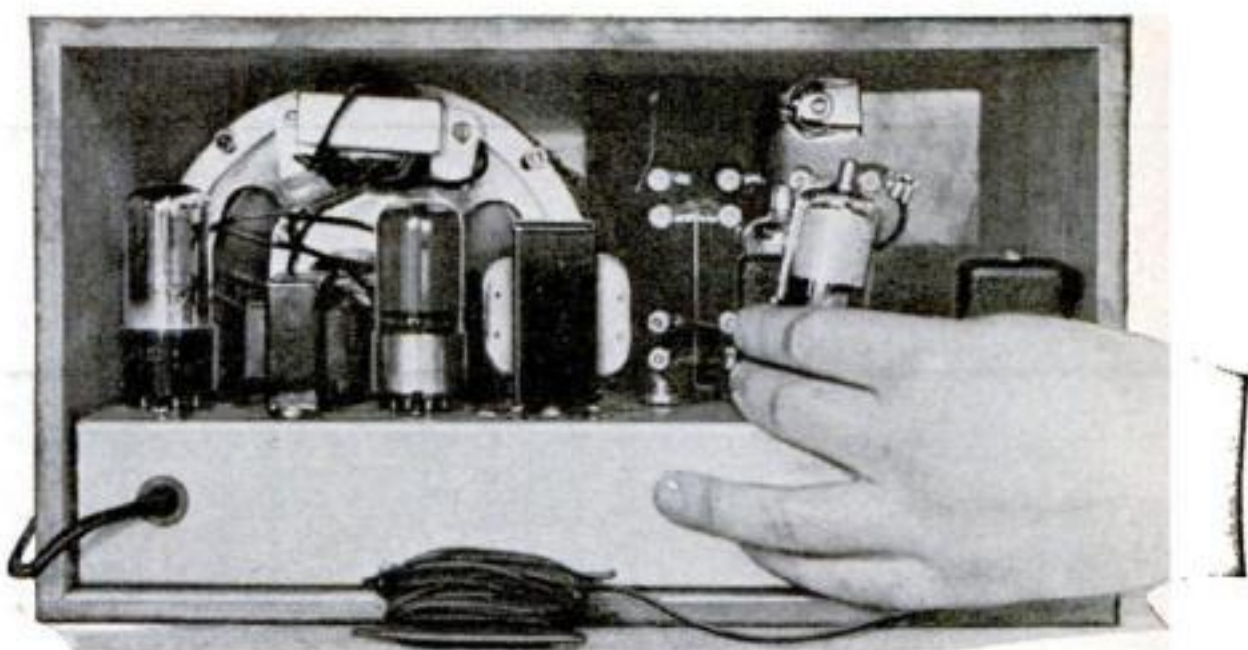
Tunes Novel Receiver

panel contact them, pairs of trimmer condensers become grounded. Since each pair has been pretuned to a station, sliding the panel serves to connect just the right capacities into the circuit to tune it to the desired wave length. The range of the condensers being wide, they can be adjusted with a screw driver to bring in any four stations in the broadcast band.

How the eight trimmers and their contacts are wired is clearly shown in the diagram. There are just two precautions that must be observed—the condensers must be insulated from the metal chassis, and the front panel must be of composition and not of metal.

Four of the latest-type tubes make up the heart of the circuit. The high heater voltage of these tubes makes it possible to eliminate the usual filament resistor built into the line cord and to substitute a simple wire-wound resistor which can be mounted on the chassis.

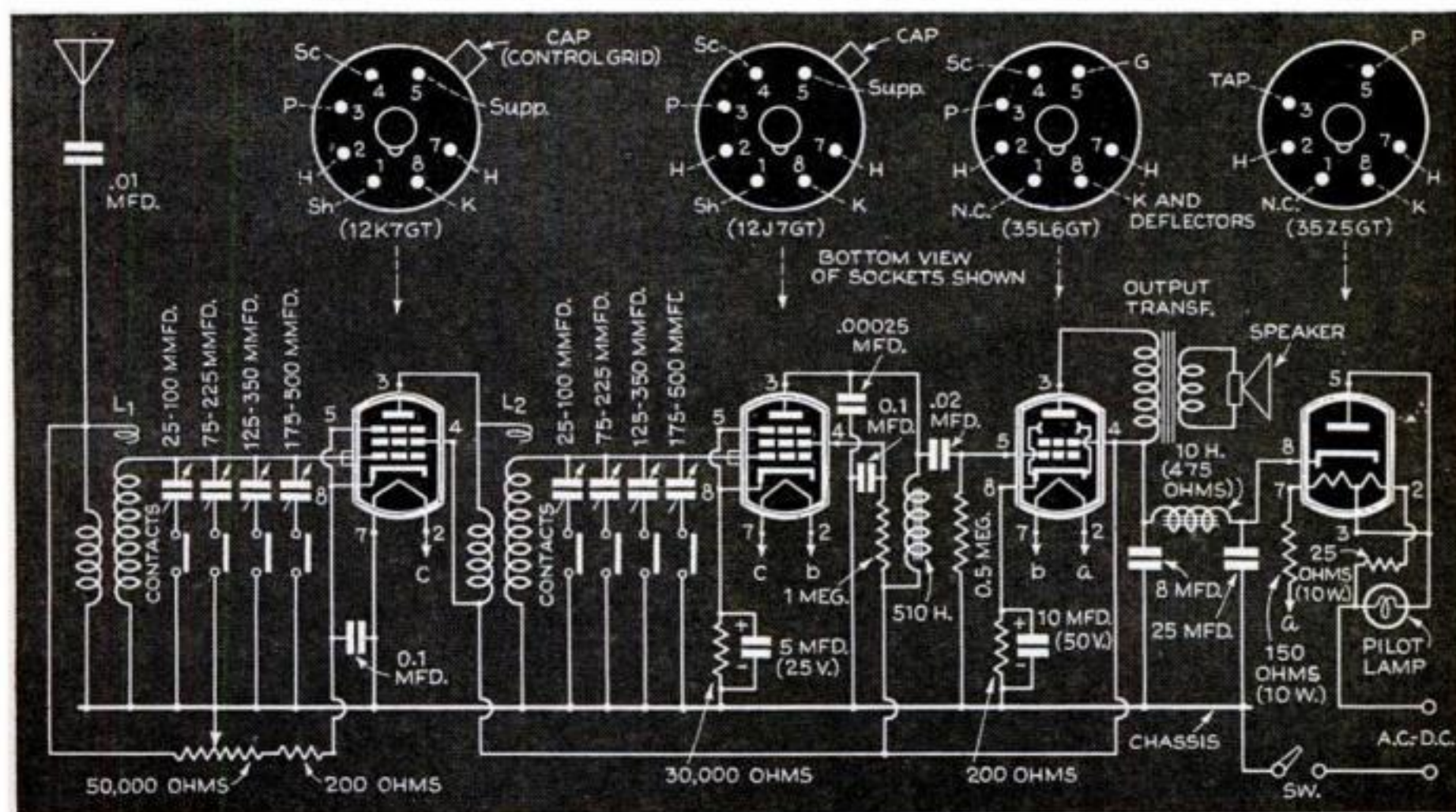
A 10-henry choke with a resistance of 475 ohms, and a dual 8-25-mfd. electrolytic



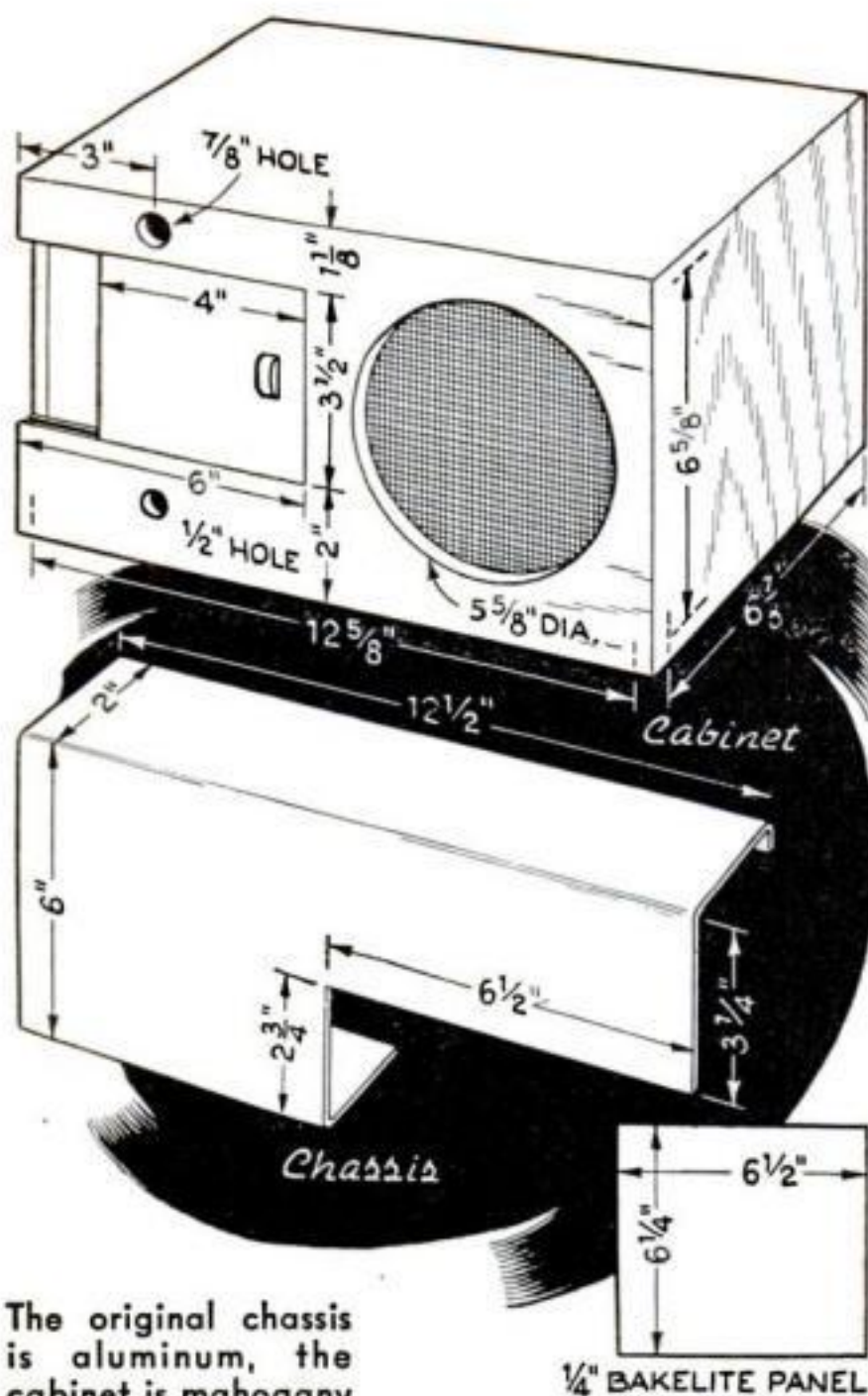
New-type tubes make it unnecessary to use a line-cord resistance

condenser serve to filter the rectified plate voltage and are adequate for providing hum-free reception. Electrolytic condensers are also used to by-pass the 30,000-ohm grid-bias resistor in the cathode lead of the detector tube and the 200-ohm grid-bias resistor of the power tube (35L6GT). These small electrolytic condensers are of the dry cartridge type and are rated at 25 volts and 50 volts respectively.

Impedance coupling was chosen for the audio-frequency stage and consists of a high-impedance choke (510 henry, 6,470 ohm) in the plate lead of the detector, a



How the various parts are connected. The trimmer condensers must be pretuned to the desired stations



The original chassis is aluminum, the cabinet is mahogany

1/4" BAKELITE PANEL

.02 mfd. coupling condenser, and a 500,000 ohm (1/2 meg.) fixed resistor.

The cost of this receiver is extremely low and the special tuning arrangement costs no more than a good two-gang condenser. No ground is necessary and any antenna can be used.

LIST OF PARTS

Volume control, switch, 50,000 ohm.
Filter choke, 10 henry.
High-impedance choke, 510 henry.
Trimmer condensers, two, 25-100 mmfd.
Trimmer condensers, two, 75-225 mmfd.
Trimmer condensers, two, 125-350 mmfd.
Trimmer condensers, two, 175-500 mmfd.
Dual electrolytic condenser, 8-25 mfd, 250 v.
Cardboard electrolytic, 10 mfd. 50 v.
Cardboard electrolytic, 5 mfd, 25 v.
Tubular condensers (two), .1 mfd, 200 v.
Tubular condenser, .01 mfd, 200 v.
Tubular condenser, .02 mfd, 200 v.
Mica condenser, .00025 mfd.
Resistor, carbon, 1 meg., 1/2 watt.
Resistor, carbon, 1/2 meg., 1/2 watt.
Resistor, carbon, 30,000 ohm, 1/2 watt.
Resistor, carbon, 200 ohm, 1/2 watt.
Resistor, carbon, 200 ohm, 1 watt.
Resistor, wire-wound, 150 ohm, 10 watt.
Resistor, wire-wound, 25 ohm, 10 watt.
Miscellaneous: Antenna and radio-frequency coils, tubes, chassis, cabinet, sockets, speaker, etc.

All Wave



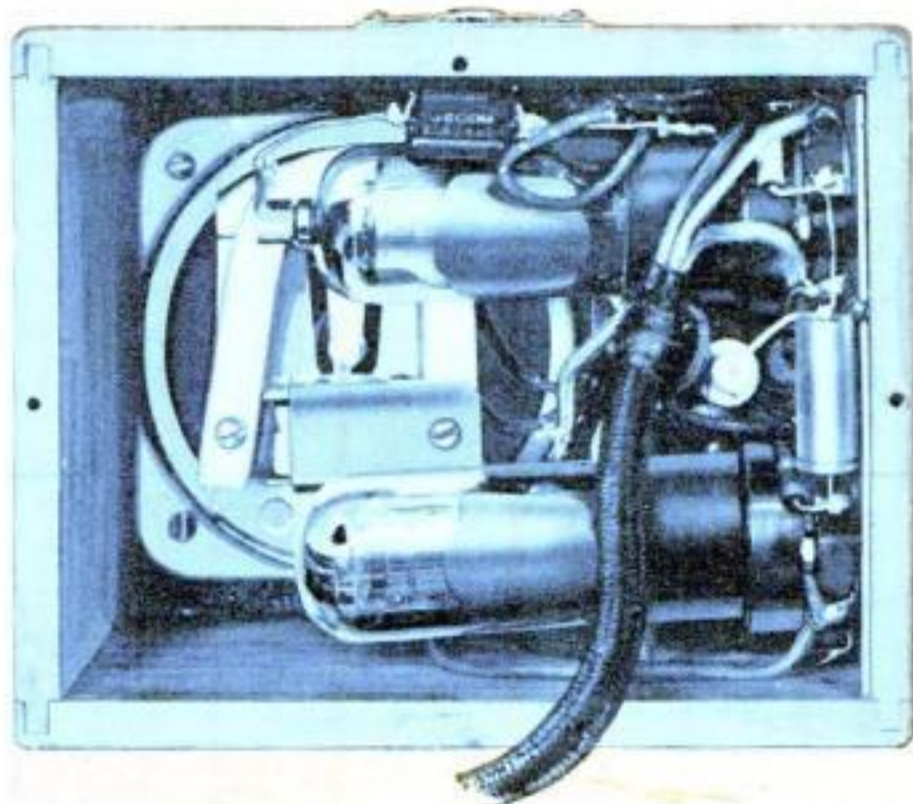
EXTREMELY simple to assemble, this compact loudspeaker receiver will bring in foreign as well as domestic broadcasts. Built around two of the new low-drain 1 1/2-volt battery tubes, the set not only packs a great deal of power, but is extremely economical to operate.

A set of six ready-made plug-in coils provide coverage for the various short-wave and broadcast bands. These coils, which plug into a socket conveniently located on top of the cabinet, should be of the two-winding, four-prong type. A midget, .00014-mfd. variable condenser used for tuning is wired across the secondary or grid winding. The smaller winding, called the tickler, is connected to the outside lugs on a 20,000-ohm variable resistor which serves as the regeneration control. The on-off switch, shown in the "A" minus lead, is mounted directly on the back of this 20,000 ohm variable resistor and is operated by the same control knob.

A 2.1-mh. plate choke wired into the plate circuit of the detector helps to provide smooth regeneration, so that the maximum sensitivity can be obtained when tuning in on the short waves.

Bands on Two Tubes

COMPACT LOUDSPEAKER SET IS INEXPENSIVE TO BUILD



Rear view of the receiver with its back removed to show the tubes and other parts. The coil is mounted on top, as shown in the photo at the left

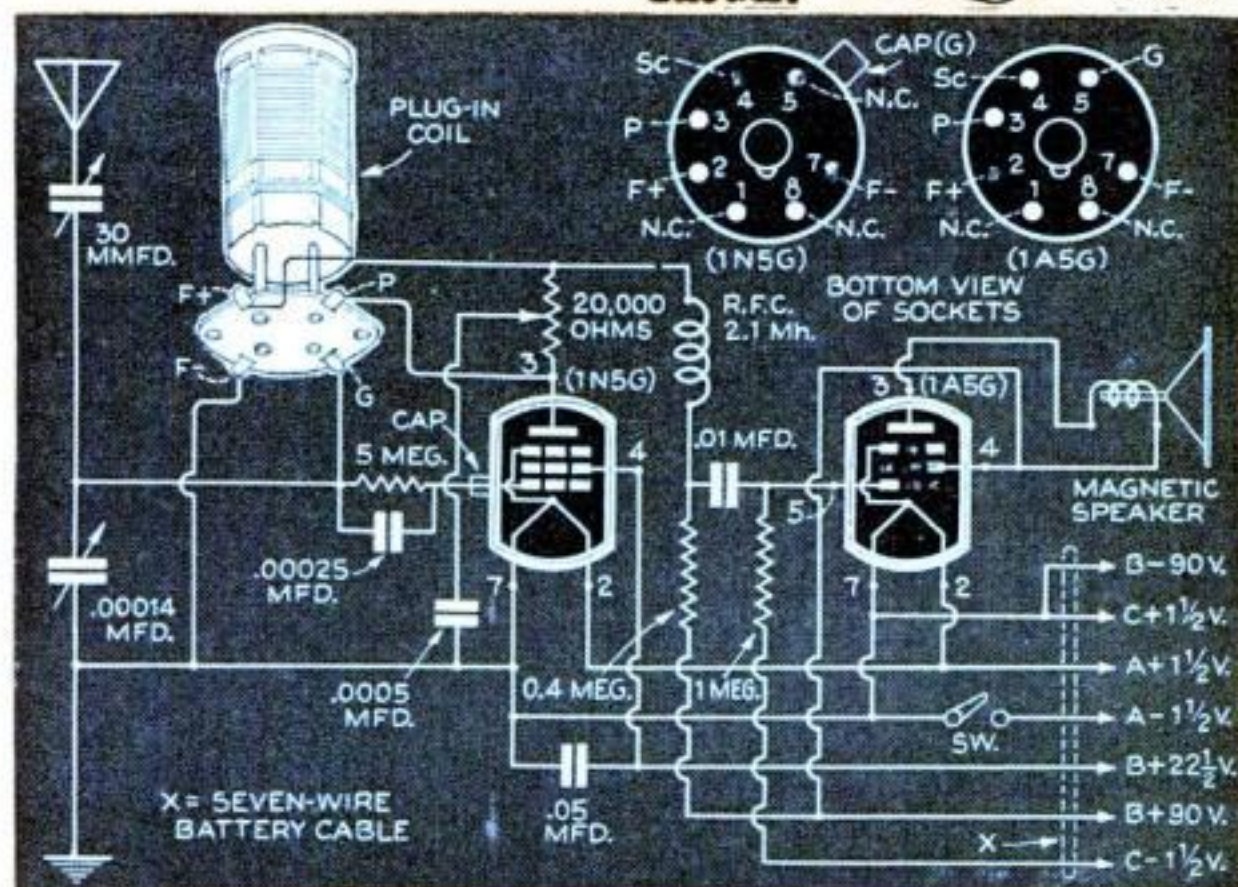
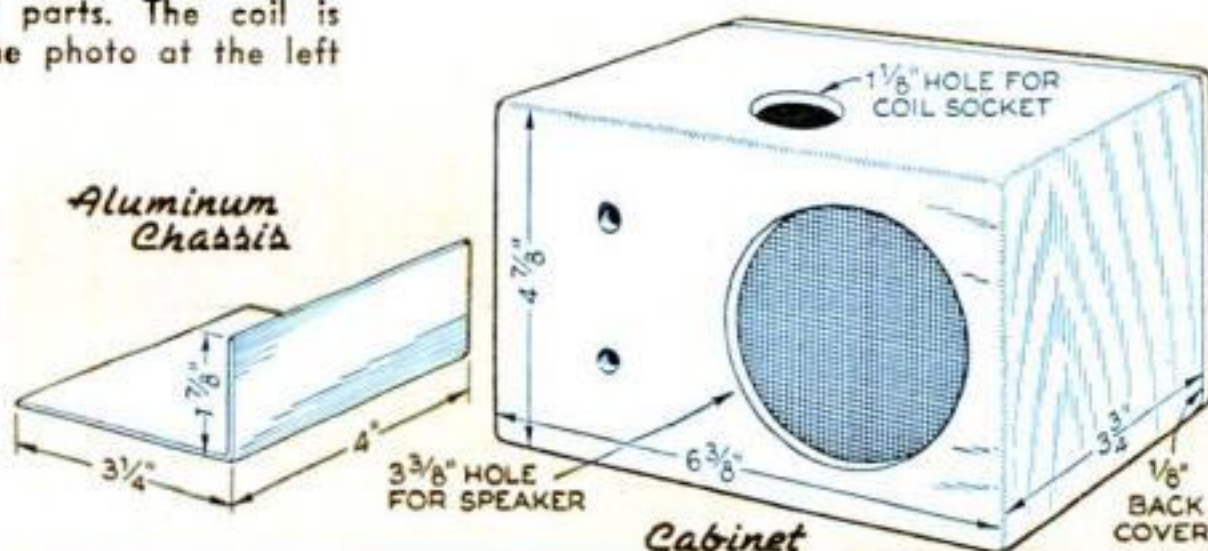
WHAT YOU NEED

Tuning condenser, .00014 mfd.
Variable resistor, wire wound, 20,000 ohm.
Switch coverplate, S. P. S. T.
Midget radio-frequency choke, 2.1-mh.
Midget trimmer condenser, 3-30 mmfd.
Magnetic speaker, 3 in.
Tubular condenser, .01 mfd, 600 v.
Tubular condenser, .05 mfd, 600 v.
Mica condenser, .0005 mfd.
Mica condenser, .00025 mfd.
Resistor, carbon, 5 meg. $\frac{1}{2}$ watt.
Resistor, carbon, 1 meg., $\frac{1}{2}$ watt.
Resistor, carbon, 400,000 ohm, $\frac{1}{2}$ watt.
Miscellaneous: four-prong wafer socket, two octal sockets, set of four-prong coils, battery cable, batteries, tubes (1N5G and 1A5G), etc.

For the grid leak resistor (5 meg.), a higher than normal value was chosen. This was done to operate the detector tube at its maximum sensitivity. The experimenter can try even higher values (any resistance up to 10 meg. may be used).

The antenna is directly coupled to the grid winding by means of the 35-mmfd. trimmer condenser. A good outside antenna, sixty feet in length, must be used.

If difficulty is experienced in obtaining adequate regeneration, reverse the leads to the tickler coil. If this fails to bring results, increase the capacity of the .00025-mfd. plate by-pass condenser to .0005-mfd., or decrease the capacity of the antenna trimmer condenser by unscrewing the adjusting screw.



Low-drain 1 1/2-volt tubes make this circuit economical to operate

SEALED-BEAM LIGHTS

FOR YOUR OLD CAR

WHEN the new sealed-beam headlights came out, I set to work to see if I could work out a simple way to adapt them to the Ford I was driving. By the time I got through, I had them on my car. The same system will work for any Ford through the 1936 models, and, with a few changes, with many other cars.

First, remove the headlight lens frames and lenses. Then remove the lamp sockets from the lamp housings, including the entrance units at the housing bases. Now make two essential parts— $\frac{1}{8}$ "-thick sheet-metal adapter rings with an outside diameter the same as that of the original lens, and an inside diameter of $6\frac{5}{8}$ ". Line one side of these with inner-tube rubber to serve as a gasket where they will contact the rims of the sealed-beam lamps. Fasten these adapter rings in each old lens frame with the same clips that formerly held the old lenses.

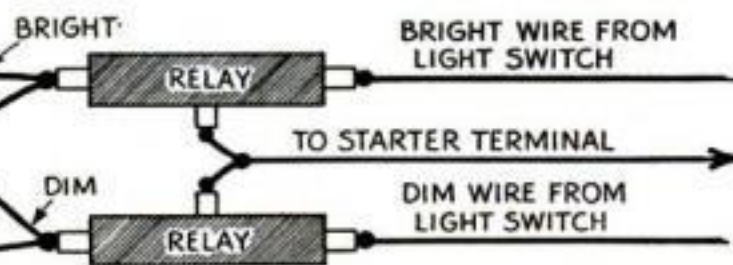
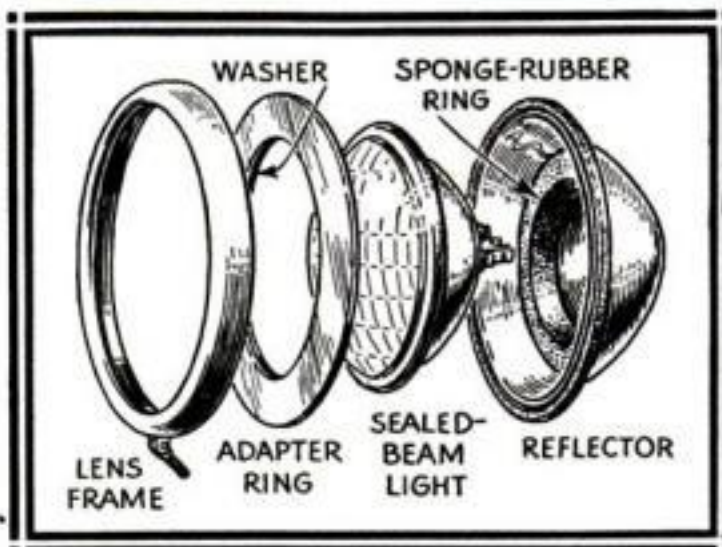
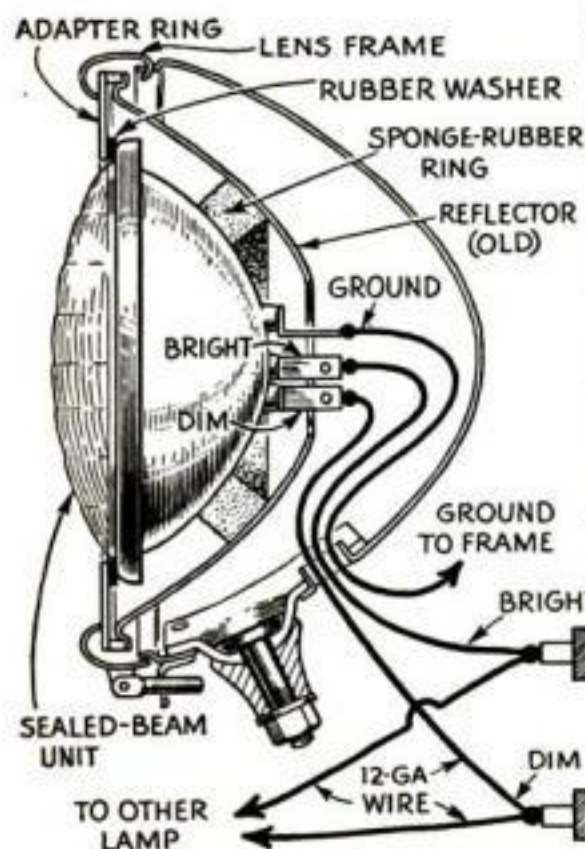
Using the old reflectors, cut 2" holes in their dead centers, completely eliminating the old sockets. A $\frac{1}{2}$ "-square strip of sponge rubber is now fastened with rubber cement to form a ring 2" in from the edge of



Fitted inside your old headlight shells, the sealed-beam bulbs will give you lighting advantages of a new car

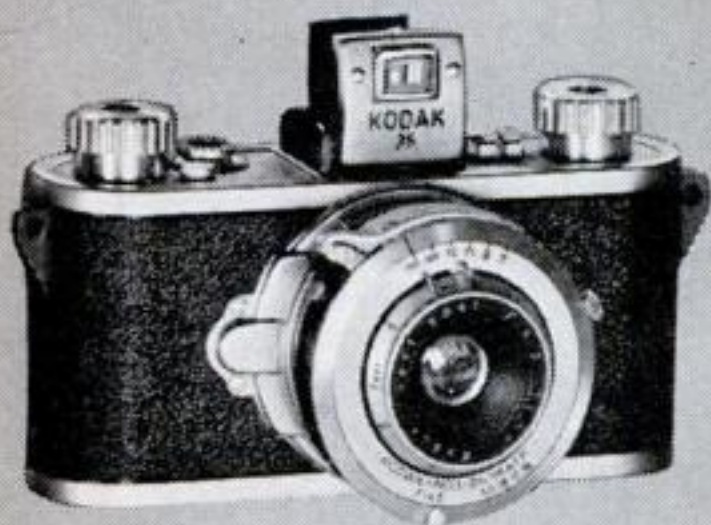
each reflector. Run the ground, dim, and bright wires through the lamp housings and reflectors and attach each ground wire to the upper terminal of each bulb, the dim wire to the lower left terminal, and the bright to the right. The regular wires will do, but it's better to use headlight relays and heavier wires. Set the bulbs against the rubber rings on the old reflectors, and clamp them with the lens frames and adapters. Adjustments may be

made with the regular lamp-mounting swivel. The bulbs should be aimed straight ahead so that the upper beams drop 3" in 25'. The lower beams will then be correct. I believe that this will be found to be the simplest and most effective way of applying these lights.—HENRY EWING.



How various elements are assembled. You discard the original lens and bulb, and make one new part. Use relays for best results

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KODAK 35 (f/4.5)

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KODAK 35 (f/3.5)

Kodak Anastigmat Special lens and 1/200 Kodamatic shutter, double-exposure prevention. \$33.50.

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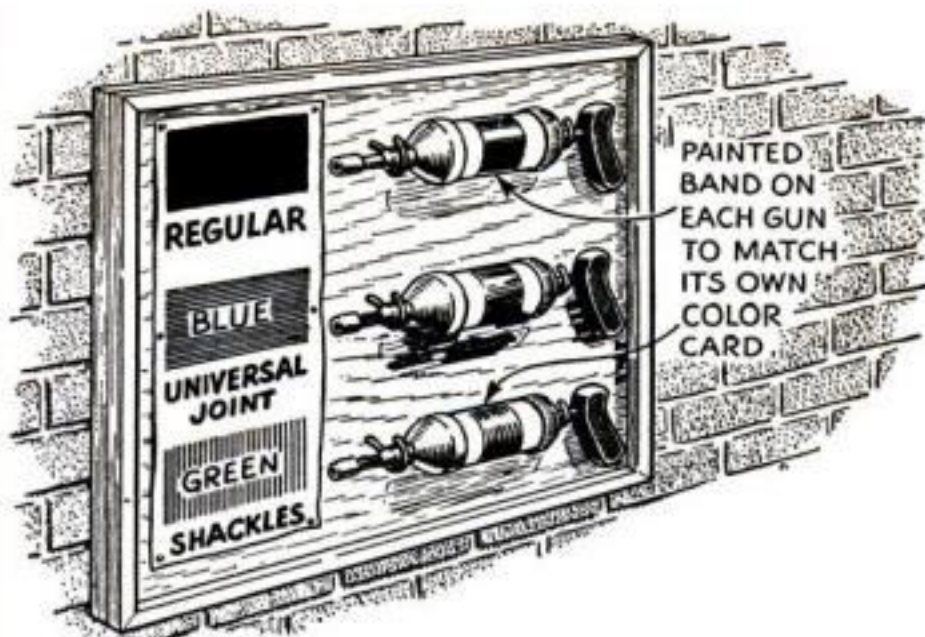
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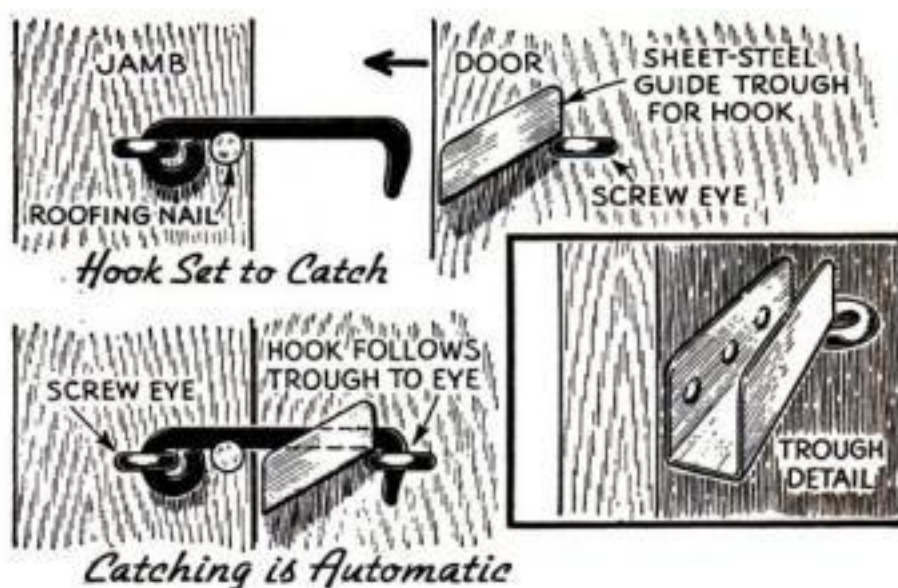
BY THE MAKERS OF MOBILOIL



Color Bands Help Select Proper Grease Gun

SERVICE-STATION proprietors, or car owners who do their own greasing jobs, can save time and avoid the mistake of selecting the wrong grease guns by means of a simple expedient. Just paint a red band around the barrel of the gun holding, say, the regular high-pressure grease, a blue band around the gun holding the universal-joint grease, and a green band around the spring-shackle gun. A chart with colored rectangles, giving the key to the system, may then be tacked on the wall or the grease-gun rack.—W. C. W.

Sliding Door of Garage Latches Automatically



MY GARAGE has a sliding door which hooks on the inside. I found it a nuisance always to have to lock the hook and screw eye from the inside and then leave by the side door. The simple arrangement shown above solved my problem. A sheet-metal track screwed to the door guides the hook as the door shuts, dropping it into the screw eye. A large-head nail holds the hook so that it enters the track properly.—F. H.

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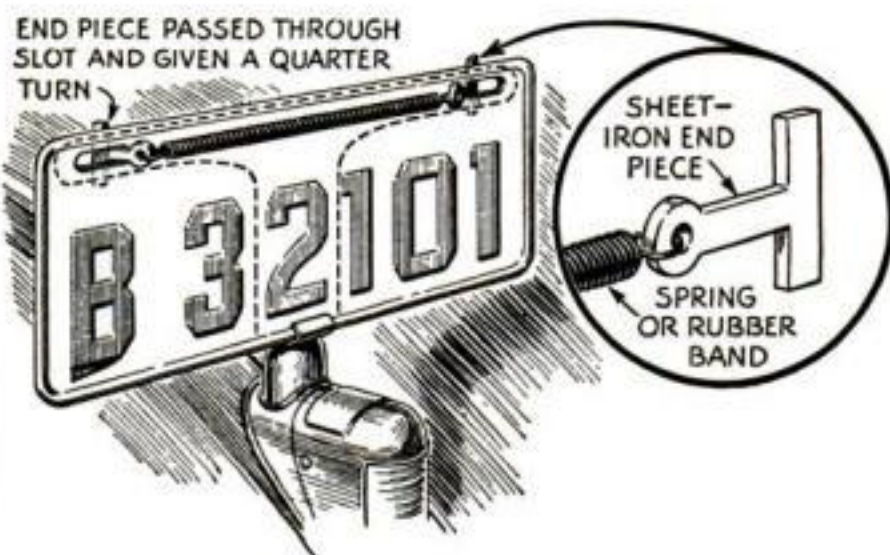
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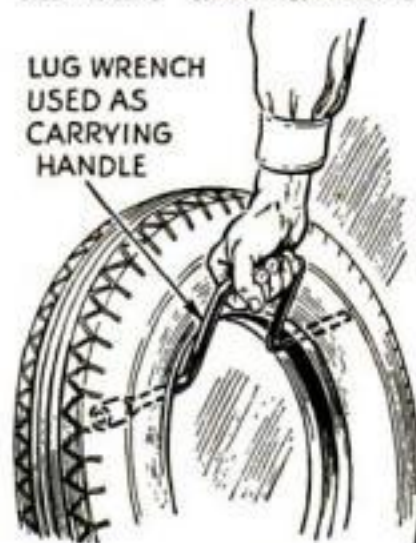
END PIECE PASSED THROUGH
SLOT AND GIVEN A QUARTER
TURN



GARAGE owners, automobile salesmen, and dealers will find the device sketched above a valuable timesaver in changing license plates on cars, a task they are often required to do several times a day, as dealers' plates are transferred from one car to another. A hole is drilled through each of two pieces of soft iron cut out as indicated. The pieces are joined by a coil spring or rubber band and then inserted through the bolt holes in both license plate and supporting bracket. Given a quarter turn, they will not fall out, while the spring provides the necessary tension to hold the plate in place.—J. G.

Lug Wrench Is Handle for Carrying Heavy Tire

CARRYING an automobile tire casing to a garage or repair shop from the car, often a difficult and awkward task, can be made



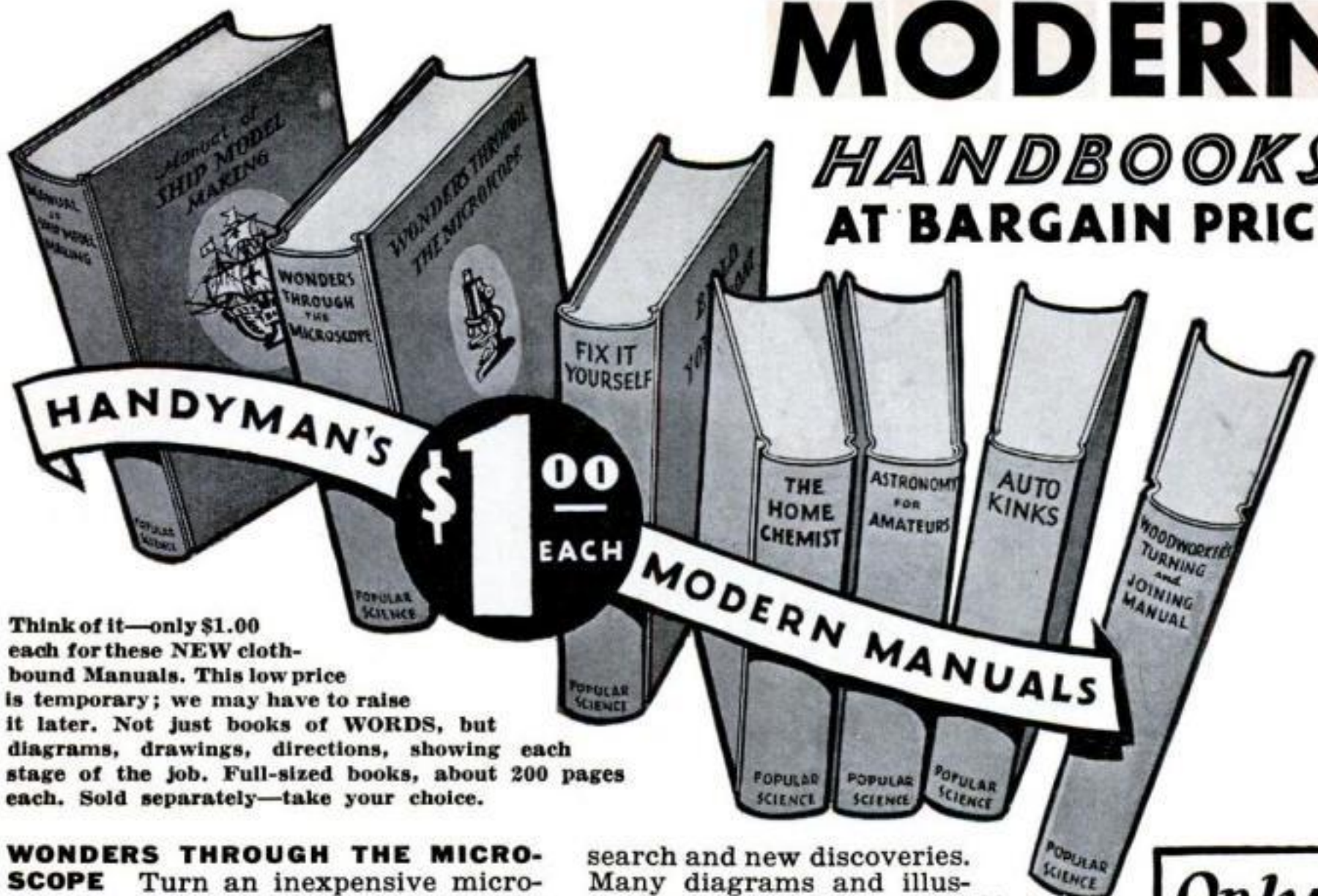
easier by employing the rim wrench used to loosen and tighten the wheel bolts as a carrying handle. Merely insert the ends of the wrench into the open slot of the casing and lift it by the protruding handle, as shown at the left.—G. E. H.

Spare Key Hidden in Car

SOONER or later, every driver finds himself without a car key at a critical time. A spare key fastened with cellulose adhesive tape to an inconspicuous spot under the dash will then come in mighty handy. If the same key is used in locking the door, it may be even better to hide it somewhere under the hood, to insure against a lockout.—D. N.

MODERN

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(Continued on page 218)

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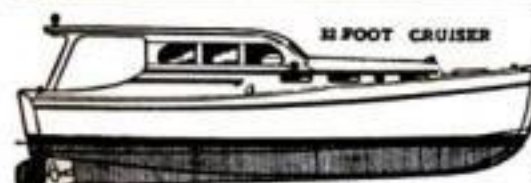


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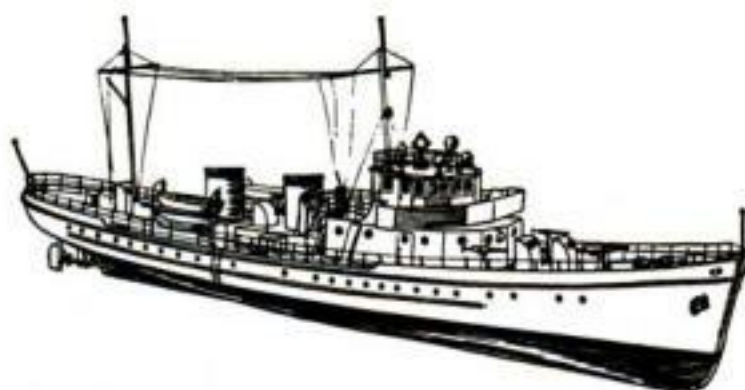
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(Continued from page 216)

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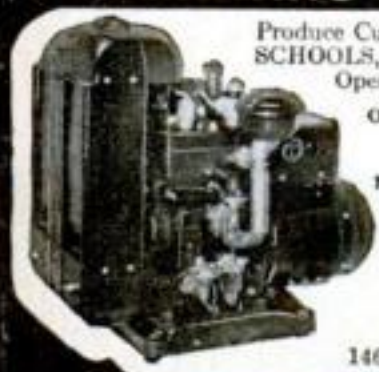
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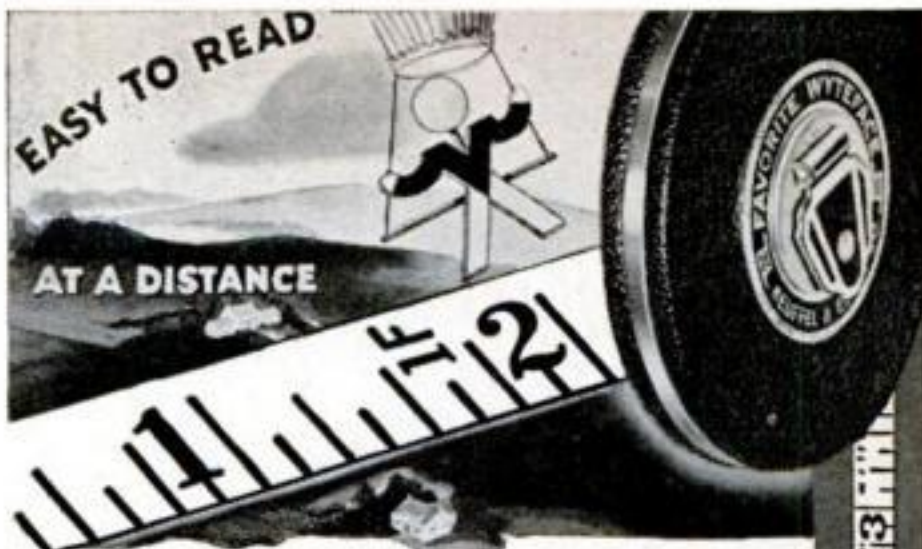
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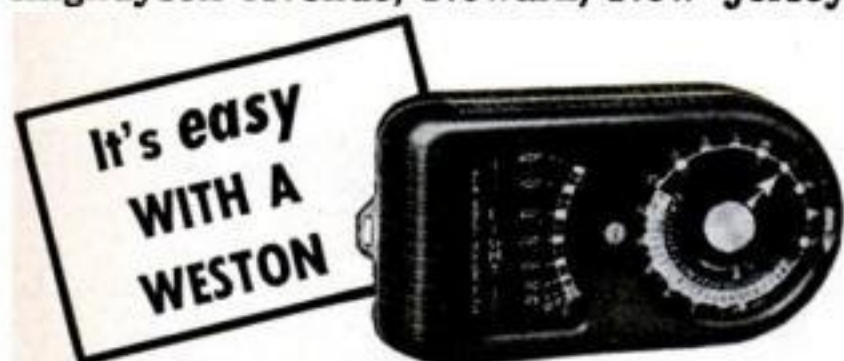
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Drying Film-Tank Reel

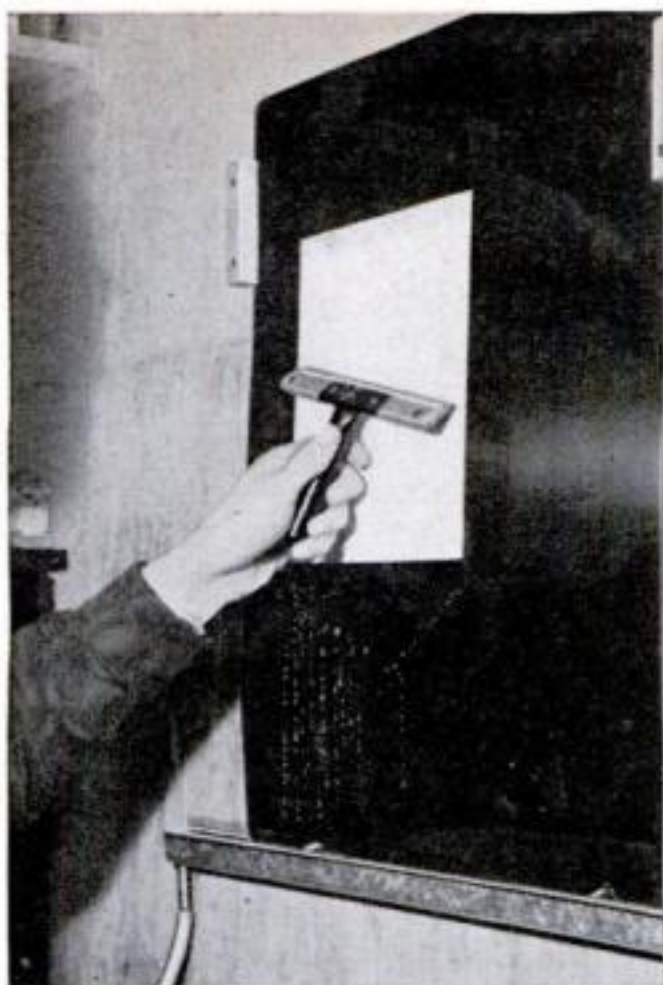
THERE are several methods of removing water from the reel of a roll-film tank so that it can be loaded again without waiting for it to dry, but one of the best ways is to flow the grooves with alcohol. After the surplus has drained off, the reel will dry within a few seconds.—K. M.



How to Copy Soft Prints

IN COPYING soft-focus prints, difficulty may be avoided by tacking a strip of printed or typewritten paper across the print as shown. The strip permits sharp focusing, yet does not obscure the print outlines. Remove the strip before exposure.—R. O. L.

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Ferrotyping Plate Mounted on Wall to Save Space

FERROTYPING prints in a small darkroom may be simplified by constructing a wall bracket similar to the one illustrated. Two wooden lugs, slotted to hold the top edges of the ferrotyping tin, are fastened on the wall about six feet up from the floor. A small trough of galvanized iron or copper supports the tray and catches the excess water, which is carried off through rubber tubing to the sink.—MURRAY KNOWLTON.

• • •

Too cold a developer not only delays the process of development, but also results in negatives that are weak and thin.

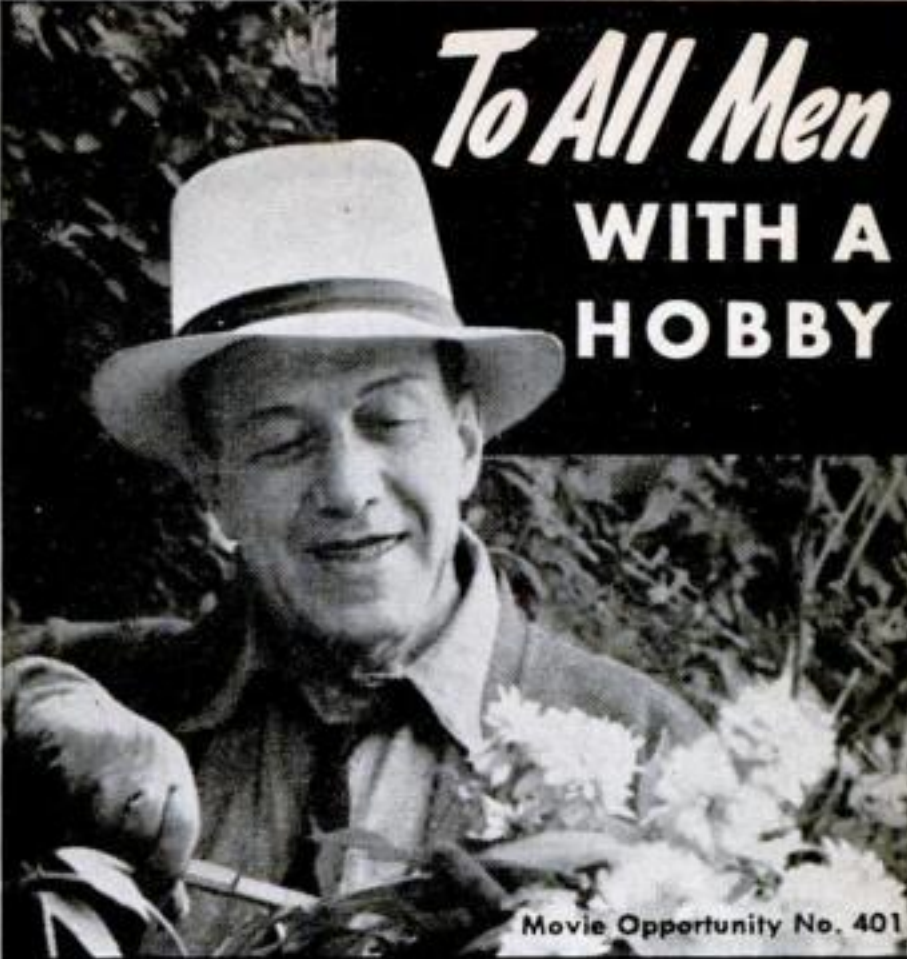
Film Tank on Rubber Pad Is Easily Agitated

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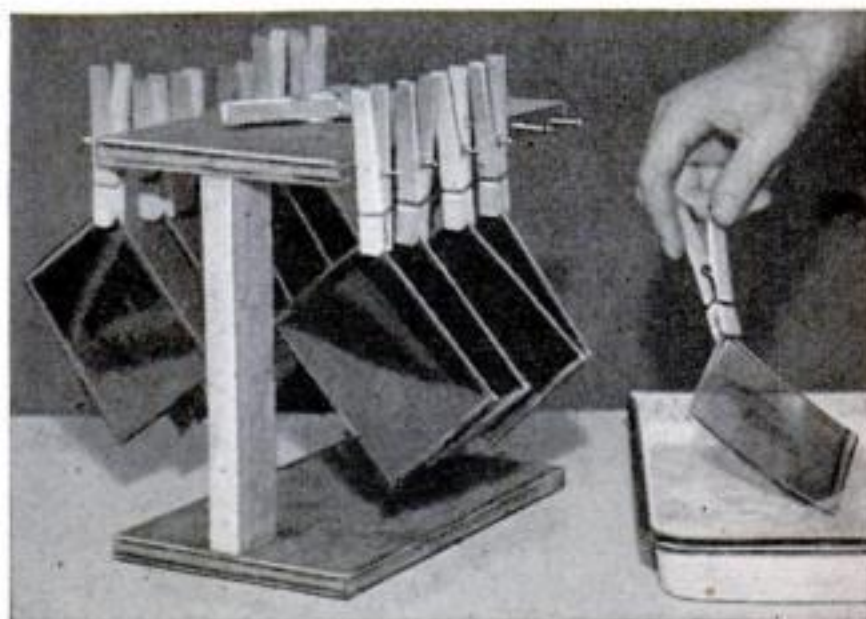
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Negatives Dry Quickly on Portable Rack

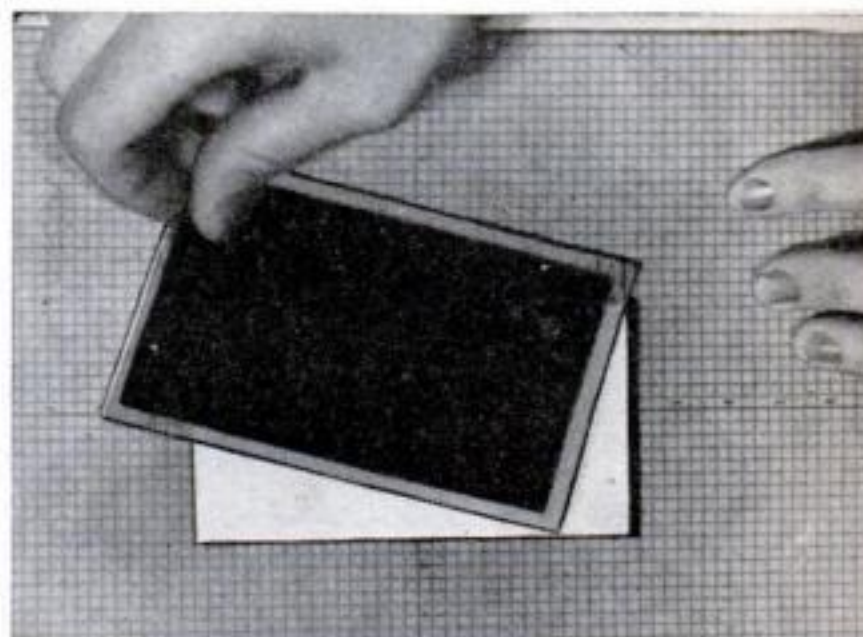
THIS type of portable drying rack for film-pack and cut-film negatives can be loaded in the darkroom and then carried to a warmer part of the house for rapid drying. A rack large enough to carry a dozen 4" by 5" negatives may be made from two pieces of $\frac{1}{2}$ " wood or fairly thick plywood 6" by 9", two pieces $\frac{3}{4}$ " by 1" by 8", twelve spring wooden clothespins, and finishing nails. Space the nails $1\frac{1}{2}$ " apart and leave about 1" projecting. Finish the rack with varnish or shellac.—ARMISTEAD WHARTON.



The rack will hold a dozen 4" by 5" negatives

Tape Keeps Film in Place

TO HAVE a print come up in the developer with a black streak on the edge of the picture area because the negative or mask slipped is very discouraging. This is not difficult to prevent, however. The opening in the masking chart is cut $\frac{1}{8}$ " longer than the negative to be masked, and a strip of photographic tape is applied on the underneath edge so as to project $\frac{1}{8}$ " over the opening at the end. This will leave a sticky edge of the tape exposed and will hold the negative securely.—A. REX MCGEEHON.



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MONTAMOWER DISTRIBUTING CO.

326 Houseman Bldg. GRAND RAPIDS, MICHIGAN

Laundry-Mark Detective

(Continued from page 63)

small portion of his coat had been pressed against the tree and remained unconsumed. The lining bore the marking: "H 8421 3-5." It might have been inked in, Yulch found, at any one of half a dozen dry-cleaning establishments near New York. A quick canvass of these shops brought detectives to a dry-cleaner in Mt. Vernon, N. Y., who recognized the mark and identified the man as his own father-in-law. From this starting point, detectives traced the actions of the victim and proved that his death was not a murder but a strange and fantastic form of suicide.

Many of the cases that Yulch has solved, of course, are less spectacular. But they all illustrate the value of his file. Amnesia and accident victims have been identified through dry-cleaning and laundry marks on their clothing. People who have dropped dead in the street have been saved from pauper's graves by Yulch's file.

Recently, many larger laundries in the United States have installed machines which mark shirts and other items with invisible ink that fluoresces under ultra-violet light. Yulch has included in his file samples of the work of every machine of the kind now in use in the country. He has, as part of his equipment, a portable ultra-violet lamp for examining clothing for such secret marks.

Criminals, who are aware of the significance of fingerprints, have yet to learn the almost equal importance of telltale laundry marks and dry-cleaning symbols.

In a recent candy-store stickup, some hoodlums shot and killed the son of the proprietor. The get-away car, a black sedan, was found later on, abandoned in another part of the city. It had been wiped carefully to remove all fingerprints. However, a hundred yards away, in a vacant lot, the pair of blue trousers which had been used as a rag was discovered rolled up and dropped behind a bunch of weeds. The killers, who knew all about fingerprints, were unaware that the garment contained dry-cleaning marks that, through Yulch's file, would lead the police directly to them.

So outstanding has been the success of the Long Island detective's "hobby" file that recently he was called to New Jersey to make suggestions for the establishment of the first state-wide police file of laundry and dry-cleaning marks. Eventually, Yulch expects to see a national bureau at Washington, D. C., similar to the fingerprint file of the Federal Bureau of Investigation. Such a central clearing house would aid scientific crime fighters in all parts of the country.

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New Patents Forecast Your 1942 Car

(Continued from page 81)

will these dream cars look like? Picturing body styles of the past and the present, one after the other according to the year of their appearance, forms an excellent way of forecasting the body style of the future, according to a statement made recently by Edwin L. Allen, a prominent authority on the subject. Windshields, which in early cars stuck up vertically, have tipped backward to merge with the curving top. Cars through the years have drawn in their boxlike backs to arch forward in a graceful roof line. Meanwhile, the constantly flattening shape of the rear deck has shifted passengers farther and farther toward the front of the body.

Now if this trend of car design continues, it must inevitably lead to the true streamline shape, the teardrop form—wide at the front and tapering back to a point at the rear. The passenger compartment will continue to inch forward, and finally change places with the engine, which will land at the back of the car where many designers have felt it should have been placed when the infant automobile had yet to get its first pair of fenders.

And what do the car owners themselves want in the car of the future? According to reports of automobile manufacturers, their customers concentrate on three demands: roominess, efficiency, and low price. And that is exactly what the rear-engine streamline car will provide when it rolls off the production line:

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CORRECTION

LABORATORY tests and industrial processes involved in the coloring of roofing shingles, described and illustrated in the article, "How Science Puts Color to Work," in the April issue of this magazine, were erroneously stated to be used in the manufacture of asbestos shingles. As a matter of fact, the particular operations shown are used in the making of asphalt shingles, by one of the leading concerns in that field.

GRANDMA CALLED IT SINFUL

IN MY DAY we women couldn't do much about those bristles on the manly chin that scraped like sin. But nowadays any woman's a fool to put up with one of those human porcupines. Which reminds me, my dear, Margie has picked the most delightful young man—always so well groomed—he must shave twice a day—yet his skin's never the least bit irritated looking. It's what Margie calls a Barbasol Face.



YOUR OWN WIFE or sweetheart would be a lot happier, too, if you got yourself a Barbasol Face. Barbasol not only gives you the cleanest, smoothest, sweetest shave you ever had—its beneficial oils protect your skin from razor irritation while you shave—and leaves it feeling softer, smoother, and fresher after you shave. That's why Barbasol has changed the shaving habits of a nation. (Your druggist sells Barbasol in three sizes, 25¢, 50¢, 75¢. Five Barbasol Blades, 15¢.)



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Flying Four Miles Up!

(Continued from page 106)

the ship levels off. Then, as power drops to 2,000, speed picks up. You are zipping eastward 240 miles an hour. Should you peer into the pilot's cabin, you would note among his scores of instruments two altimeters, one reading 20,000, the other 10,000.

Unlike anything you have experienced in the past, the cabin's interior has gained altitude only half as fast as the airplane itself. The blowers have raised the pressure in the cabin to make up for the loss of pressure in the upper air.

Your flight continues. "Cheyenne next stop," the stewardess announces. You are cruising four miles up, yet the cabin is only two miles up, and this busy Wyoming town lies 6,000 feet above sea level. How will the three get together? The copilot resets the altitude control, and as the ship glides 12,000 feet downward, the cabin "descends" 4,000 feet. Both altimeters indicate 6,000 feet as the plane lands and you step onto the concrete runway for a brief walk before continuing toward the rising sun.

Although brand-new, the plane in which you ride already is age-tested. First models have been in the air on scores of flights covering a year. Round corners on the wind shields, rivets set flush in the metal skin, shorter antenna masts, outer wing tips which turn down for greater stability, noses made of wood to provide better radio-beam reception—all these better their safety and speed.

In 125 test flights, Al Reed and his assistants flew the DC-4 nearly four times around the world. At four panels set up in the broad cabin, engineers made countless observations of mechanical performance in flight. From the first DC-4, sold recently to Japan for transport service in the Orient, has evolved another DC-4, the one Americans soon will know. Standing twenty-seven feet, ten inches tall, her wings will stretch 117 feet, six inches from tip to tip; while the fuselage measures ninety-two feet, three inches from nose to tail. Weighing 35,000 pounds empty, the ship will carry a useful load of 15,000 pounds, with a day-plane capacity of forty-five persons, including a crew of five. Unlike the Boeing Stratoliner, of thirty-three-passenger capacity, she will be fitted with a tricycle landing gear: two main wheels and a third under the nose.

These two ships will mark the layman's first climb into the substratosphere for daily rides along the superhighway of the air, and will provide him with comforts, safety, and speed undreamed of a few short years ago.

Please mention POPULAR SCIENCE when writing to advertisers.

Kitchen Chemicals

(Continued from page 196)

immersed in cold water. This constitutes a miniature condensing system.

Gently heat the tubeful of washing soda with a soft or waving flame, and then increase the heat. You will plainly see steam coming from the crystals, and two teaspoonfuls or so of water will condense in the receiver.

The white substance left in the heated test tube is still sodium carbonate. However, each of its molecules now has only one molecule of water attached to it, or no water at all, depending upon the temperature to which it has been heated.

Whatever its water content, washing soda (sodium carbonate) effervesces when treated with a dilute acid, releasing bubbles of carbon dioxide gas. Baking soda (sodium bicarbonate) does the same, as you have observed if you ever tried mixing it with vinegar (dilute acetic acid).

Sugar makes another interesting chemical to experiment with. To produce a compound that probably is new to you, dissolve as much sugar as you can in some pure grain alcohol. Now add a strong solution of lye. A white precipitate of a chemical called sodium succinate will be formed.

Place a razor blade in plain water, and it will become rusty in a few hours. Another blade, placed in a water solution of sugar, will show no sign of rusting.

"Oxygen bath salts," which liberate free oxygen in the bath water, have been placed on the market. Sodium perborate, which you may find in your bathroom cabinet, can be used as the chief ingredient of a similar homemade preparation. A suitable formula calls for 270 grams of sodium perborate, 6 grams of manganese sulphate, and 10 grams of cream of tartar. (This is roughly equivalent to 9½ ounces of sodium perborate, one generous teaspoonful of manganese sulphate, and two teaspoonfuls of cream of tartar).

When two ounces or more of this mixture is placed in a bath tub filled with water, the sodium perborate decomposes and releases oxygen bubbles. The manganese sulphate acts as a catalyst, helping the reaction along without entering into it. Slight acidity, which favors the reaction, is supplied by the cream of tartar.

On a test-tube scale, you can demonstrate the same reaction in your laboratory, by adding several drops of a manganese sulphate solution to a sodium perborate solution. Oxygen gas is liberated when the two solutions mix.

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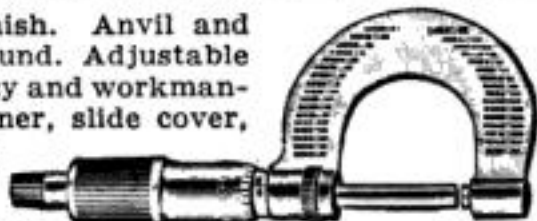
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Stovepipe Microscope

(Continued from page 197)

photographic film. When an eyepiece magnifying five times is used instead of the ground glass, the magnification is more than 100 times. The longer the focus of the camera lens, the lower the magnification for a given tube length. Also, the longer the tube, the greater the power, for a given focal length. Amateur movie-camera lenses are particularly suitable for the instrument because of their short focus and excellent qualities.

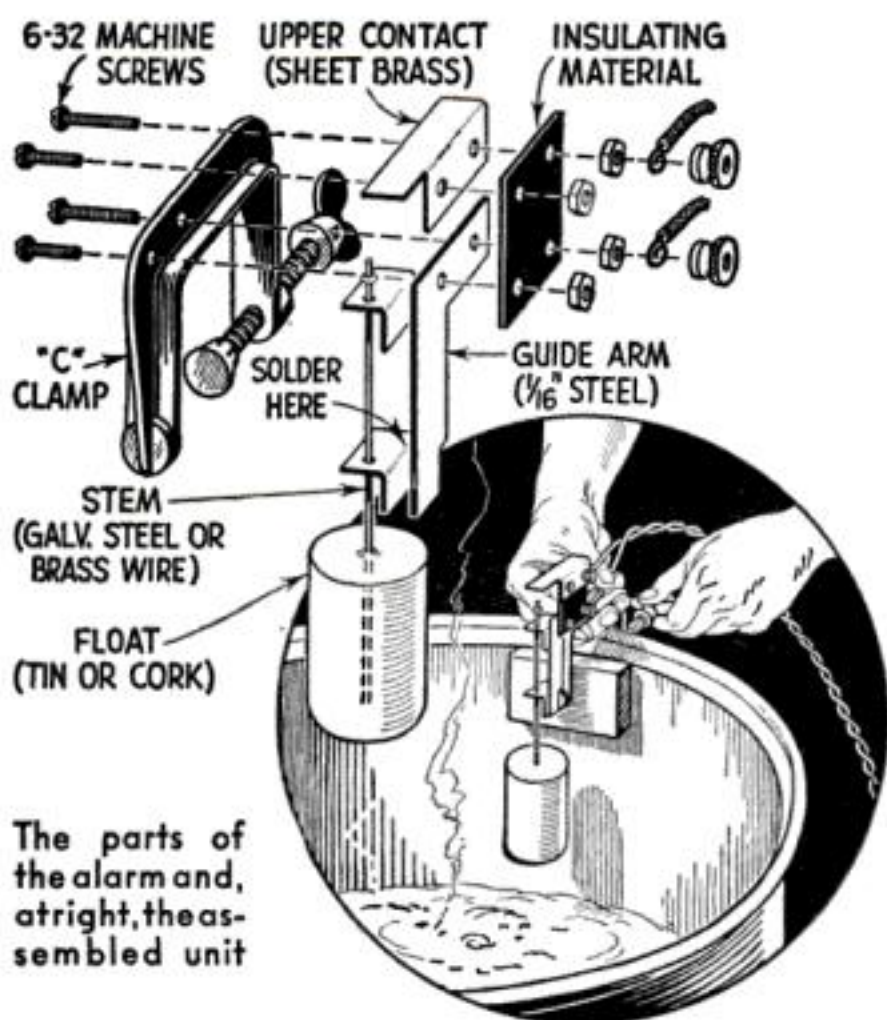
Construct a rectangular framework of $\frac{3}{4}$ " by 2" wood strips to form the base of the instrument. The overall width of the frame should be about $7\frac{1}{2}$ ", and the length sufficient to accommodate at least two 24" sections of 5" stovepipe, with an additional foot or more for the sliding object holder. Insert braces to make the frame rigid.

Mount the stovepipe between two uprights. The front support carries the photographic lens, and the rear one the ground-glass viewing screen, sensitive film, or eyepiece. Cut circles from $\frac{3}{4}$ "-thick wood to fit inside the stovepipe ends, and mount these pieces on the uprights, as shown in the drawings. The instrument illustrated was designed to be used both as a direct-vision magnifier and a camera employing $3\frac{1}{4}$ " by $4\frac{1}{4}$ " photographic film. The rear upright was made to take standard $3\frac{1}{4}$ " by $4\frac{1}{4}$ " film holders. Of course, you can vary the design to suit other types and sizes of holders or a simple sheet of ground glass.

The front member consists simply of a square piece of $\frac{3}{8}$ "-thick wood with the circular wooden stovepipe holder mounted on one side and the lens on the other. Both the front and back uprights are fastened to bases that fit the framework.

The object holder consists of a rectangular, upright piece of wood having a $1\frac{1}{4}$ " hole directly in front of the lens, and two clips for holding 1" by 3" microscope slides. The upright is attached to a base that slides along the longitudinal members of the frame. A rod, made by soldering together two solid sections from a pair of adjustable curtain rods, and threaded at the front end, controls the position of the object carrier. The threaded part of the rod passes through a nut fastened to the base of the carrier, while on the other end of the rod is a radio knob. A collar rests against one of the crosspieces of the frame and prevents the rod from moving forward. A rubber band or coil spring is installed to pull the object holder away from the lens, thereby steadying it. By

(Continued on page 230)



Alarm Clamped on Tank to Warn of Overflow

PRACTICALLY any tank or vat can be guarded against overflowing by clamping on the rim an electric alarm made as illustrated. The float may be a small evaporated milk can or a large cork. If a can is used, the stem, which is a piece of No. 12 galvanized or brass wire about 7½" long, is passed through holes punched in both ends and soldered in place.

The guide arm is cut from a piece of 1/16" steel, the dimensions of which will depend upon the size of the C-clamp used. The other parts are assembled as shown, and the stem is prevented from dropping through the guides by a ring of wire soldered about ¼" down from the upper end.

In use, one wire from an ordinary dry-battery circuit is connected to one of the upper machine screws, and the other wire to one of the lower screws. A relay could be used in place of the bell to give automatic control if desired. One of these devices has been in use for some time at a large filtration plant in Maryland and works very satisfactorily.—FRANK A. MARKLI 3RD.

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BAUSCH & LOMB

Stovepipe Microscope

(Continued from page 228)

turning the knob, the object holder can be moved until the object is in sharp focus.

Do not fasten the stovepipe sections permanently to their supports, or the latter to the framework. You will want to take a section out occasionally to lower the magnification, or add one to increase it. It is wise to include, near the center of the frame, a curved support to prevent the stovepipe from sagging when two or more sections are used at a time.

When viewing an object by transmitted light, place the instrument so that there is a window back of the object holder, or arrange a lamp in line with the lens. Light can be thrown on the front of the object by mirrors, or electric lamps or spotlights placed around the holder.

Coat the inside of the stovepipe and interior wood surfaces with a nonreflecting paint. This is important, if you want sharp images. You can make the paint by mixing drop black, obtainable at paint stores, with a little shellac thinned with alcohol.

You will find a ground-glass screen satisfactory for nearly every kind of direct-vision work, where great magnification is not desired. Arrange a wood panel to fit into the back in place of the screen. In the center of this panel bore a hole to receive a standard microscope ocular or a small, short-focus magnifier of almost any type. It has been found that some simple lenses work better than costly eyepieces. You can use the eyepiece and ground glass interchangeably. If you have a small camera with a lens that cannot be removed, you can use the lens for the objective by arranging some means of holding the camera to the front upright, after the camera back has been removed.

POPULAR SCIENCE Question Bee

HERE are the correct answers to the Question Bee on page 124. Check your own answers and give yourself five points for each one you had right. A score of 75 to 85 is good; 90 or better is excellent.

- | | | | | |
|------|------|-------|-------|-------|
| 1. a | 5. c | 9. c | 13. c | 17. b |
| 2. c | 6. b | 10. a | 14. c | 18. b |
| 3. c | 7. b | 11. c | 15. d | 19. b |
| 4. b | 8. b | 12. d | 16. b | 20. c |

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This One



7FP0-4JU-8X5H



WHEN just about ready to tell the boss a "mouthful," close your mouth tight and breathe through the nose for a few minutes. This has saved many a good man his job.

If you ever have to turn a piece having a small hole drilled through, rather than the usual center holes, hammer in a hardened steel ball to break the sharp edges. Use a ball that is about one fourth larger than the hole.

A handmade thread over $\frac{1}{2}$ " is likely to be more or less cockeyed. I believe it usually pays to screw-cut the thread to at least one third its depth and then use the die.

For certain special requirements, a cross between a square and an acme thread may solve the problem when the square form is desired, but its strength is doubtful. Why not turn an even 7-deg. side angle; in other words, slightly less than one half the acme dimensions?

There are several metals now available having a low-melting point between 200 and 300 deg. F. These may most economically be used for bending pipe, experimental work, temporary assembly, and even patching.

Some machinists refer to an end mill as just a small tool with a taper shank. However, a 12" diameter inserted-teeth mill purposely designed for end or side cutting is also properly termed an end mill.

No better four-lip core drill can be made than from square carbon or high-speed steel stock. Material of predetermined diameter is turned for the shank, and the body is cylindrically rough-ground to obtain lands. Segmental circles are then milled in on the four sides to form flutes, and the other operations are of a conventional nature.

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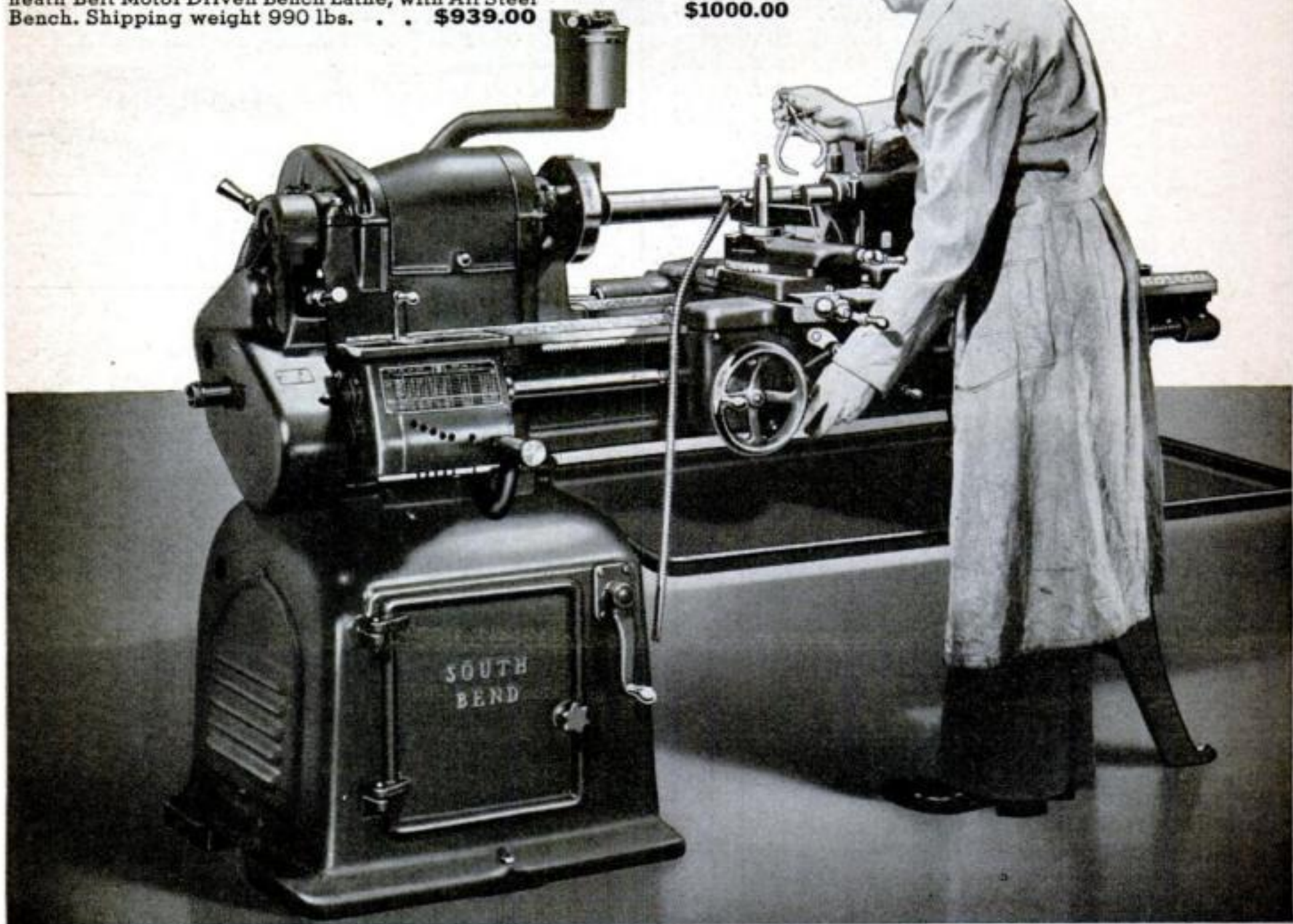
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Precision LATHES

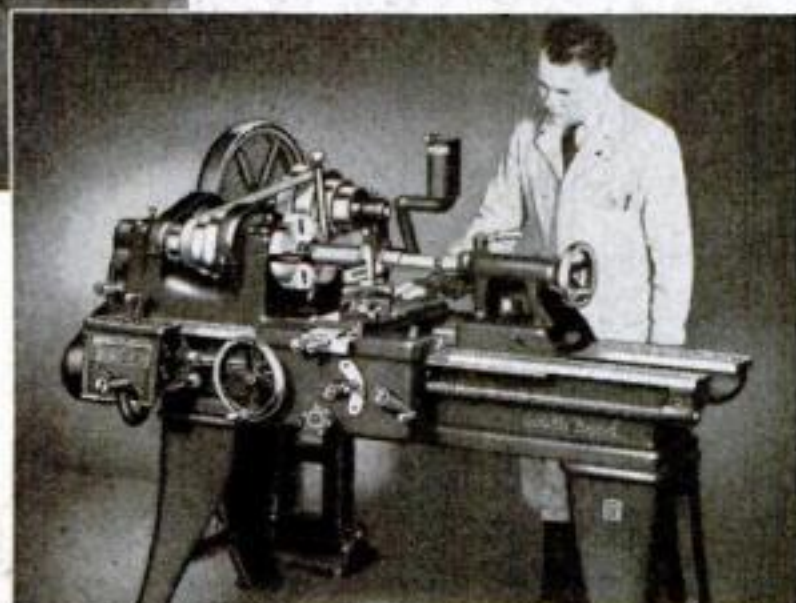
9" x 3' Workshop Model C Bench Lathe with Horizontal Motor Drive and reversing motor, complete as shown. Shipping weight 320 lbs. \$109.50



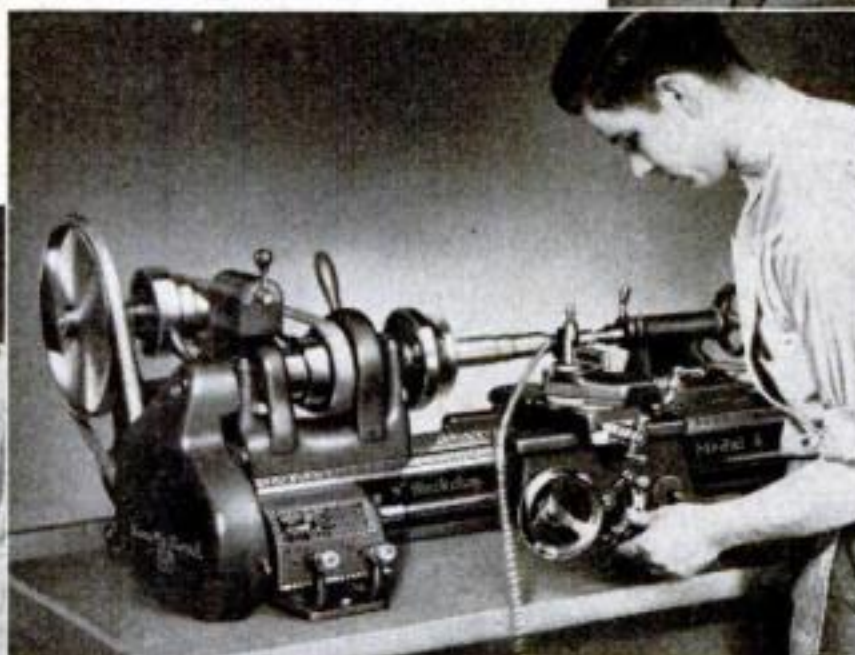
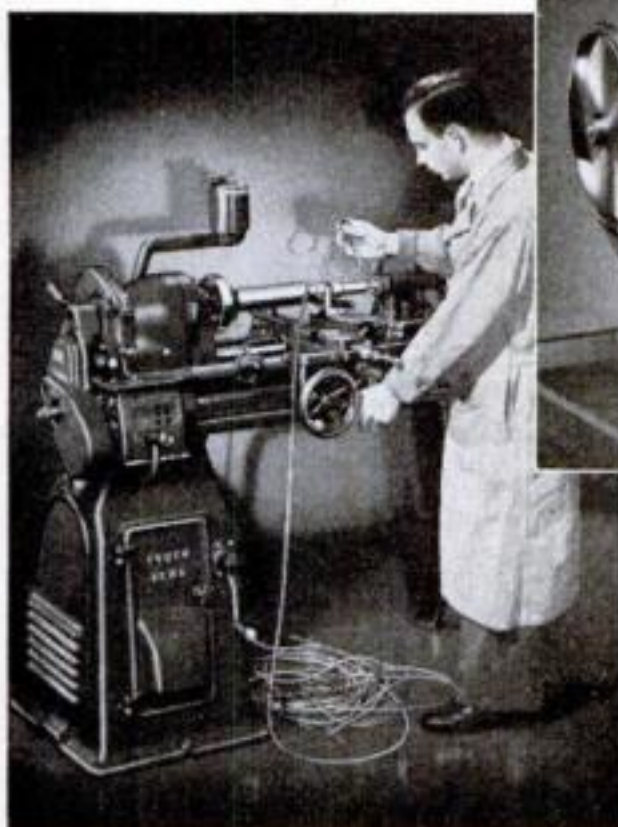
Price Reduced
\$79.50
For 9" x 3' Workshop Model C Lathe Less Drive

SIZES AND PRICES OF SOUTH BEND LATHES

Swing Size	Bed Lengths	Price Range
9" 'Workshop' Lathes	3' to 4½'	\$ 79.50 to \$ 280.50
10"—Lathes	3' to 4½'	268.00 to 854.00
10"—1" Collet Lathes	3' to 4½'	398.00 to 969.00
11"—Lathes	3½' to 5½'	388.00 to 941.00
13"—Lathes	4' to 7'	478.00 to 1144.00
14½"—Lathes	5' to 10'	609.00 to 1431.00
16"—Lathes	6' to 12'	723.00 to 1578.00



Below—11" x 4' Quick Change Gear Underneath Belt Motor Driven Lathe. Shipping weight 965 lbs. \$625.00



Above—16" x 6' Quick Change Gear Pedestal Motor Driven Lathe. Shipping weight 2165 lbs. \$938.00

Left—9" x 3' Workshop Model A Quick Change Gear Bench Lathe with Motor Drive and motor as shown. Has power carriage feeds. Shipping weight 340 lbs. \$199.50



Mail Coupon for Catalog

SOUTH BEND LATHE WORKS
847 E. Madison St., South Bend, Ind., U. S. A.
Please send catalog checked:
☐ 9" Workshop Lathe Cat. No. 50A
☐ Complete General Cat. No. 100

Size of Lathe _____
Name _____
Address _____
City _____ State _____

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